REMEDIAL INVESTIGATION

VOLUME I OF II

RAYMARK - OU6 – ADDITIONAL PROPERTIES
STRATFORD, CONNECTICUT

RESPONSE ACTION CONTRACT (RAC), REGION I

For
U.S. Environmental Protection Agency

By
Tetra Tech NUS, Inc.

EPA Contract No. 68-W6-0045
EPA Work Assignment No. 112-RICO-01H3
TtNUS Project No. N4106

April 2004

TETRA TECH NUS, INC.

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Appendix B - Human Health Risk Evaluation
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ACRONYMS

ATSDR	Agency for Toxic Substances and Disease Registry
AVS/SEM	acid volatile sulphide/simultaneously extractable metals
bgs	below ground surface
CDD	chlorinated dibenzo-p-dioxins
CDF	chlorinated dibenzofurans
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	contract laboratory program
cm	centimeter
COPC	chemicals of potential concern
CSI	comprehensive site investigation
CSF	cancer slope factor
CT DEC	Connecticut Direct Exposure Criteria
CT DEP	Connecticut Department of Environmental Protection
CT DPHAS	Connecticut Department of Public Health and Addiction Services
CT PMC	Connecticut Pollutant Mobility Criteria
CT RSR	Connecticut Remediation Standard Regulation
DABS	Dermal Absorption Factors
DHHS	Department of Health and Human Services
dL	Deciliter
DNAPL	dense non-aqueous phase liquid
DOT	Department of Transportation
DPW	Department of Public Works
ECG	electrocardiograph
ELI	Environmental Laboratories, Inc.
EPA	United States Environmental Protection Agency
EPC	exposure point concentrations
ERA	ecological risk assessment
ESI	expanded site inspection
FEMA	Federal Emergency Management Agency
FID	flame ionization detector
FRW	fraction of property estimated to contain Raymark waste
FS	Feasibility Study
GA/GAA	State of Connecticut Classification for Drinking Water source
GB	State of Connecticut Classification for Non-drinking Water source
GC/ECD	gas chromatograph with electron capture detection
GPR	ground penetrating radar
GPS	Global Positioning System
HEAST	Health Effects Assessment Summary Tables
HHEM	Human Health Evaluation Manual
HHRA	human health risk assessment
HI	hazard index
HQ	hazard quotient
IEUBK	Integrated Exposure Uptake Biokinetic model
ILCR	incremental lifetime cancer risk
IRIS	Integrated Risk Information System
kg	kilogram
LOAEL	lowest observed adverse effect level
µg	microgram

ACRONYMS (cont.)

MEP	multiple extraction procedure
mg	milligram
mph	miles per hour
NAPL	non-aqueous phase liquid
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NERL	New England Regional Laboratory
NESHAP	National Emission Standard for Hazardous Air Pollutants
NGVD	National Geodetic Vertical Datum
NOAA	National Oceanic and Atmospheric Administration
NOAEL	no observed adverse effect level
NTCRA	Non-time critical response action
OSWER	Office of Solid Waste and Emergency Response
OU	operable unit
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PID	photoionization detector
ppb	parts per billion
ppm	parts per million
PRG	preliminary remediation goal
RAF	relative adsorption factor
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
RfC	reference concentration
RfD	reference dose
RI	remedial investigation
RME	reasonable maximum exposure
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SAS	special analytical services
SPLP	synthetic precipitation leaching procedure
SRI	Strategic Redevelopment Initiative
SSL	soil screening level
SVOC	semi-volatile organic compound
TAL	target analyte list
TCDD	2,3,7,8-tetrachloro-dibenzo-p-dioxin
TCL	target compound list
TCLP	toxicity characteristic leaching procedure
TEF	toxicity equivalence factor
TERC	Total Environmental Restoration Contract
TEQ	toxicity equivalent
TOC	total organic carbon
TtNUS	TetraTech NUS
UCL	upper confidence limit
USGS	United States Geological Society
VOC	volatile organic compound
VSP	vertical sampling program
XRF	x-ray fluorescence
yr	year

ES EXECUTIVE SUMMARY

This Remedial Investigation (RI) report for the Raymark Industries, Inc. Superfund Site – Operable Unit (OU) 6 - Additional Properties Study Area has been prepared by Tetra Tech NUS, Inc. (TtNUS), as authorized by the U. S. Environmental Protection Agency (EPA) under Work Assignment No. 112-RICO-01H3, Contract No. 68-W8-0045. This RI report presents the findings of field investigations undertaken over a 10-year period (1993-2003) to locate additional properties in Stratford, CT that may or may not contain Raymark waste. The results of these field investigations have identified 24 properties that have been impacted by waste from the former Raymark Facility. A comprehensive Feasibility Study (FS) identifying the cleanup options being considered for these 24 properties and other areas within the Raymark site will be issued as a separate document.

This RI report is structured as follows: Section 1 provides background information regarding the overall Raymark Industries, Inc. Superfund Site; Section 2 discusses the establishment of the OU6 study area, including an explanation of the Raymark waste definition; Section 3 is a property-by-property presentation of the sampling information and location of Raymark waste on each of the 24 properties; and Section 4 is a summary of the RI report. This RI report was developed for soils contamination and does not include assessment of other media, such as sediments, surface water, and groundwater.

The interpretation of the data and information compiled for each of the 24 properties included in this RI report indicates that:

- In addition to the Raymark waste indicator contaminants (chysotile asbestos, lead, and either copper or polychlorinatedbiphenyls (PCBs) - Aroclor 1268 only), fill throughout the OU6 study area is also contaminated with volatile organic contaminants (VOCs), semi-volatile organic contaminants (SVOCs), pesticides, other PCBs, dioxins, furans, and metals.

- Although contamination is ubiquitous across the OU6 study area, the contaminants and concentrations are not uniformly distributed, due, primarily, to irregular dumping practices. The sample location maps in Section 3 identify the estimated Raymark waste areas on each of the 24 properties.

- Asbestos is present at concentrations greater than 1% at all 24 properties. This fact alone may be sufficient to justify remedial actions. The presence of pavement and vegetative

cover at most of the OU6 properties reduces the potential inhalation exposures to asbestos; however, disturbances of asbestos-containing soil through digging will increase the potential for airborne asbestos exposures and associated inhalation risks. This underscores the importance of avoiding disturbances of asbestos-containing soils prior to remediation and using health protective measures during remediation. Asbestos was not quantified as part of the estimated potential risks to human health.

- Potential risks to human health from estimated areas of Raymark waste are in excess of EPA acceptable limits or levels of concern based on estimates of hazard indices, cancer risk, and/or modeled blood lead levels at 14 of the 24 properties. Cancer risks at 6 additional properties fall within EPA's target risk range of 10^{-4} to 10^{-6}.

- Although no quantitative ecological risk assessment was performed as part of this RI, based on available data, minimal ecological risk is assumed for the properties within the OU6 study area, assuming erosion and migration of wastes are controlled.

A small number of additional properties still need to be investigated as the result of access issues at specific properties that were previously included in the over 200 properties evaluated initially as part of OU6. These properties will be evaluated in the future by EPA to determine the potential presence of Raymark waste.

1.0 INTRODUCTION

This Remedial Investigation (RI) Report (report) evaluates the nature and extent of contamination in the soils from 24 properties that resulted from past disposal practices of the Raymark Industries, Inc. Facility (former Raymark Facility or Facility), located in Stratford, Fairfield County, Connecticut (Table 1-1 and Figure 1-1). Tetra Tech NUS, Inc. (TtNUS) prepared this report for the U.S. Environmental Protection Agency (EPA) under a Response Action Contract (RAC) Work Assignment No. 112-RICO-01H3, Contract No. 68-W6-0045, to partially fulfill the requirements for Raymark Operable Unit No. 6 (OU6) – Additional Properties. This RI report was developed based on the approved Draft Work Plan Option Period, June 2001, and approved Draft Work Plan, Amendment No. 2, July 2002, and subsequent amendments.

As requested by EPA, this RI incorporates information compiled in the *Final Area I Remedial Investigation, Raymark – Ferry Creek OU3* (TtNUS, October 1999b), the *Draft Final Area II Remedial Investigation, Raymark – Ferry Creek OU3* (TtNUS, November 2000a) and the *Draft Final Area III Remedial Investigation, Raymark – Ferry Creek OU3* (TtNUS, November 2000b). Additional efforts to evaluate groundwater contamination beneath and downgradient of the former Raymark Facility are being conducted by TtNUS under Raymark - Operable Unit No. 2 (OU2-Groundwater), Work Assignment No. 126-RICO-01H3. This RI was prepared in accordance with the *Interim Final Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA, 1988), and is consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA); and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

1.1 Purpose of Report

This report documents the investigations performed, and evaluates the nature and extent of soil contamination, and associated public health and environmental risks, within 24 properties where waste from the former Raymark Facility has come to be located. Figure 1-2 identifies the location of each of these 24 properties, and Table 1-1 lists the 24 properties.

The purpose of this report is to provide the documentation necessary to support a Feasibility Study (FS) and the selection of a source control remedy in a Record of Decision (ROD).

The overall objectives of this RI report are to:

- Compile and evaluate applicable soil data needed to characterize the conditions at each property and to determine the nature and extent of contamination in the soil impacted by waste from the Raymark Facility;

- Evaluate the risks to human health and the environment at each property;

- Use existing information to summarize ecological conditions at the properties, where available; and

- Serve as the data resource for developing, screening, and evaluating a range of potential alternative remedial actions that address the contamination within the OU6 study area and support a comprehensive Feasibility Study.

1.2 Report Organization

This report contains a discussion of investigation activities, results, and interpretations, references, tables, and figures for each property, and appendices. Appendix A contains the boring logs, Appendix B contains supplemental and backup data for the Human Health Risk Evaluation, and Appendix C contains the analytical data used to produce this report. Appendix D contains a discussion of the field investigations associated with this OU6 RI.

This report is organized as follows:

- Section 1, Introduction, discusses the purpose and scope of the report, summarizes the background and history of the Raymark Industries, Inc. Superfund Site, and presents the physical characteristics of the overall Raymark Superfund site.

- Section 2, Establishment of the OU6 Study Area, presents the identification of properties evaluated, the development of the definition of Raymark waste, the description of the Raymark waste area used for each property, a physical description of the general setting of the area around the properties, and the general approach for identifying the nature and extent of contamination, determining the fate and transport mode of contaminants, and

assessing the human health and ecological risks within the study area.

- Section 3, Property Evaluations, presents a discussion of the physical characteristics of each of the 24 properties included in the OU6 study area, the known nature and extent of contamination on each property, the fate and transport of that contamination, and the estimated potential risks to human health and the environment.

- Section 4, Summary and Conclusions, summarizes Section 3 and states conclusions reached about the contaminated areas for each property.

1.3 Background

This section summarizes the history of the former Raymark Facility, describes the Raymark Superfund Site, and identifies other activities associated with the former Raymark Facility. Refer to the *OU1 Final Remedial Investigation Report* (HNUS, 1995) for further details on Facility operating history, environmental activities, permits, and compliance history.

1.3.1 History of Raymark Facility and Environs

The Raymark Facility, formerly named Raybestos - Manhattan Company, was located at 75 East Main Street in Stratford, Fairfield County, Connecticut, at latitude 41° 12' 02.5" N and longitude 73° 07' 14.0" W (see Figure 1-1). The Raymark Facility operated from 1919 until 1989, when the manufacturing plant was shut down and permanently closed; however, the property was not cleaned up until 1997. A remedial investigation and feasibility study (RI/FS) for the Raymark Facility was completed in 1995 (HNUS, 1995). Subsequent to the completion of the RI/FS, EPA designated the facility as Operable Unit No. 1 (OU1). In 1996 and 1997, as part of the property cleanup activities, the Facility buildings were demolished and a permanent cap was placed over the contaminated areas on the property. Based on Stratford tax map information, the Facility occupied 33.4 acres. Raymark manufactured friction materials containing asbestos and non-asbestos components, metals, phenol-formaldehyde resins, and various adhesives. Primary products were gasket material, sheet packing, and friction materials including clutch facings, transmission plates, and brake linings. As a result of these activities, soils at the Facility were contaminated primarily with asbestos, lead, copper, and polychlorinated biphenyl compounds (PCBs).

During the facility's 70 years of operation, it was common practice to dispose of manufacturing waste as "fill" material both at the Raymark Facility, as well as at various locations in Stratford. The manufacturing wastes from various plant operations were used to fill low-lying areas on-site to create additional space for facility expansion. Based on aerial photographs and reported knowledge of site activities, on-site disposal occurred between 1919 and 1984, and progressed essentially from north to south, across the Raymark Facility. As a result of disposal of these manufacturing wastes on the property, soils at the facility became contaminated primarily with asbestos, lead, copper, and PCBs. New buildings and parking areas were constructed over these filled areas as the manufacturing facility expanded. Raymark also offered manufacturing wastes as "free fill" to employees, residents, and the town.

The Raymark Facility was underlain by an extensive manmade drainage network. Water and wastes from the manufacturing operations were collected and diverted into the facility drainage system, which also collected stormwater runoff. These liquids were transported through the drainage system network, mixed with lagoon wastewaters, and then discharged to Ferry Creek.

Solids were allowed to settle in Lagoon Nos. 1, 2, and 3 prior to discharge of clarified wastewater and unsettled solids to Lagoon No. 4. Lagoon No. 4 discharged directly into Ferry Creek. Discharge of wastewater to Lagoon Nos. 1, 2, and 3 ceased in 1984. These lagoons were closed in December 1992 and January 1993. During the fall of 1994, stormwater drainage that had exited the Raymark Facility through Lagoon No. 4 was diverted around this lagoon and connected directly to the storm sewer. The storm sewer ultimately discharged to Ferry Creek. Lagoon No. 4 was closed in early 1995, prior to the placement of the permanent cap over the property.

During the operation of the lagoons, the settled material in the lagoons was periodically removed by dredging. During the facility's 70 years of operation, it was common practice to dispose of both this dredged lagoon waste and other manufacturing waste as fill material (referred to as waste in this report) both at the Raymark Facility and at various locations in Stratford. Several of the locations that received waste are included within the area designated as the OU6 study area for this RI report (Figure 1-2).

A number of these off-the-facility locations, where Raymark waste was disposed, were contaminated with asbestos, lead, PCBs, and/or other contaminants at levels that posed a potential threat to public health. To abate the potential health threat to residential properties, residential locations were remediated under EPA CERCLA time-critical removal actions during 1993 to 1996. The excavated

material from these residential locations was placed under a permanent cap at the Raymark Facility. Raymark waste identified at one municipal property, Wooster Middle School, was also excavated, stored, and ultimately placed under a permanent cap at the former Raymark Facility. Additional properties have been identified as locations where Raymark waste was disposed; these 24 properties are the subject of this RI report.

Based on this information, EPA listed the former Raymark Facility and properties that contain waste from the Raymark Facility, on the National Priorities List (NPL) on January 18, 1994. Listing on the NPL authorizes the expenditure of CERCLA funds. The property was granted a final listing status on April 25, 1995.

1.3.2 Raymark Superfund Site Description and Setting

Contaminated areas associated with Raymark Superfund Site have been divided into nine operable units. EPA created these nine operable units (OUs) to help manage the cleanup process. The nine operable units are as follows:

OU1 Raymark Facility
OU2 Groundwater
OU3 Upper Ferry Creek and Surrounding Wetlands
OU4 Raybestos Memorial Field
OU5 Shore Road Area
OU6 Additional Properties Study Area
OU7 Lower Ferry Creek, Selby Pond, and Housatonic River wetlands
OU8 Beacon Point Area and Elm Street Wetlands
OU9 Short Beach Park and Stratford Landfill

The area identified as the OU6 study area includes 24 properties impacted by waste from the former Raymark Facility (see Section 2.1 for a discussion on the establishment of the OU6 study area). These properties are not all contiguous to each other and are scattered, mainly along the eastern edge of Stratford, running north to south (see Figure 1-2). The OU6 study area encompasses a total of 157.1 acres (see Table 1-1). Fourteen of the 24 properties identified in this RI report were previously evaluated within the areas described in the Raymark – Ferry Creek (OU3) investigations. The OU3 evaluations did not evaluate properties individually, rather the 14 properties were included in the larger areas identified as A-1, A-2, and A-3 in the *Final Area I Remedial Investigation,*

Raymark – Ferry Creek (OU3) (TtNUS, 1999b); Area B in the *Ferry Creek OU3 Draft Final RI, Area II* (TtNUS, 2000a); and Area D in the *Ferry Creek OU3 Draft Final RI, Area III* (TtNUS, 2000b). These OU3 investigations evaluated these 14 properties as part of a larger investigation of soil and sediments around them. EPA subsequently decided to divide its efforts into soil-only properties and sediment-only areas. This meant that the 14 properties included as part of OU3 were re-evaluated individually as part of the soil-only evaluation under this OU6 RI report. The remaining 8 properties included in this OU6 RI report are outside of the Ferry Creek OU3 study area and are located throughout the town.

Three water bodies in the OU6 study area abut some of the 24 properties: the Housatonic River, Ferry Creek, and Bruce Brook. Each is located on Figure 1-2 and on the appropriate Section 3 figures.

1.3.3 Other Raymark Related Activities

On-going activities in the vicinity of the Raymark Superfund Site that are related to the investigations conducted to support this RI include:

- Raymark Facility Closure (OU1) – Raymark waste from residential properties was brought back to the former Raymark Facility and placed under a permanent cap by EPA under the U.S. Army Corps of Engineer's Total Environmental Restoration Contract (TERC) in 1997. A soil vapor extraction system is in place to capture the bulk of the volatile organic contaminants (VOCs), especially toluene, remaining under the cap. A dense non-aqueous phase liquid (DNAPL) extraction system is removing separate phase NAPL (predominately 1,1,1-trichloroethane), which is collected in the sump portion of several extraction wells. This property is now privately owned, and has been redeveloped as a shopping center. Operation and maintenance activities are being conducted by the Connecticut Department of Environmental Protection (CT DEP).

- Groundwater RI Activities (OU2) – An RI is being prepared for Raymark - OU2 to evaluate groundwater contamination under and downgradient of the former Raymark Facility. The OU2 RI is being conducted concurrently with this OU6 RI. A Draft RI for the OU2 RI was submitted to EPA in November 2000 (TtNUS, 2000c). Additional groundwater investigations were completed in the spring and summer of 2003. A revised RI report will be issued during the winter/spring 2004 with a separate FS for OU2 to follow shortly thereafter.

- Raymark Ferry Creek RI Activities (OU3) – This operable unit encompasses the areas also known as OU7 and OU8. Three RIs (OU3 (Final), OU7 (Draft Final), and OU8 (Draft Final)) were completed in 1999, 2000, and 2000, respectively (TtNUS, 1999b, 2000a, and 2000b). This OU will be included in a comprehensive FS for OU3 (including OU7 and OU8), OU4, OU5, and OU6.

- Raybestos Memorial Ballfield Activities (OU4) – EPA issued the Final RI report, (TtNUS, 1999a). This OU will be included in a comprehensive FS for OU3 (including OU7 and OU8), OU4, OU5, and OU6.

- Raymark Shore Road Activities (OU5) – An Engineering Evaluation and Cost Analysis was released in 1999 (TtNUS, 1999c). A cap was completed in 2001. A Draft RI was released in 2002. This OU will be included in a comprehensive FS for OU3 (including OU7 and OU8), OU4, OU5, and OU6.

- Raymark Short Beach Park and Stratford Landfill Activities (OU9) – A field investigation of these areas will culminate in an RI and FS that is expected to be released in 2005.

- A substantial number of field investigations relating to soil, sediment, surface water, biota, groundwater, soil gas, and indoor air have been conducted at the former Raymark Facility and its environs. A discussion of those investigations that are pertinent to this OU6 RI study area is included in Appendix D, on Table D-1.

2.0 ESTABLISHMENT OF THE OU6 STUDY AREA

As stated in Section 1.3, Raymark Industries, Inc. (Raymark), a manufacturer of automotive friction components, was located at 75 East Main Street, in Stratford, Connecticut. During its 70 years of operation, it was Raymark's common practice to dispose of manufacturing wastes both at the Raymark Facility and at various locations in the Town of Stratford. Beginning around 1993, the EPA's Removal Program sampled soil at many commercial, recreational, and residential properties throughout Stratford for the potential presence of Raymark wastes. From 1993 through 1995, EPA conducted removal actions, consisting primarily of soil excavation, at a number of residential properties presenting the greatest health threats. Properties where sampling did not find immediate health threats were designated for EPA's Remedial Program to address. After 1995, EPA's Remedial Program focused on other health threats in Stratford resulting from wastes from the former Raymark Facility.

In April 2002, EPA's Remedial Program continued the investigation of soil at commercial, recreational, and residential properties and began to evaluate the potential for risks from long-term contaminant exposures. Procedures were developed by EPA, in consultation with the CT DEP, and reviewed by the Raymark Advisory Committee's consultant, to determine whether soils at a property had been adequately characterized, if additional sampling was needed, and the overall status of each property after characterization was complete. These procedures dictated the process of evaluating a property and determining whether Raymark waste was present.

Based on sampling results, once a property was determined to have Raymark waste contamination, the property was divided into those areas with Raymark waste and those without Raymark waste. While the entire property was sampled and evaluated for the nature and extent of contamination, the estimated area of Raymark waste on a property is the only portion of that property evaluated in the Human Health Risk Assessment (see Section 2.7 and Section 3 property write ups). Section 2.1, Identification of Properties, below, together with the figure for each property in Section 3, detail the procedures used in the evaluations.

The discussions in the following sections describe: the procedures used for identification of the 24 properties that comprise the OU6 Study area; how the definition of Raymark waste was

developed and applied to these 24 properties; the development of the estimated area of Raymark waste; the physical characteristics of the setting of the OU6 study area; the nature and extent of the contamination within the 24 properties of the OU6 study area; the principles of contaminant movement on the 24 properties; and a discussion of the risks associated with the Raymark waste and other contaminants on the 24 properties within the study area.

2.1 Identification of Properties*

The Universe of Properties[1] evaluated as part of this RI included all properties that had been identified over a 10-year period where there was a potential for Raymark waste to be present (see Figure 2-1). These locations were identified by a number of sources including, but not limited to, officials of the Town of Stratford, Raymark records and/or former employees, historical records, analytical data, and neighbors/citizens. Reasons for identification included, without limitation, knowledge of past filling/disposal activities and locations, property conditions and topography, proximity to the former Raymark Facility, and proximity to areas subject to excavation actions by EPA's Removal Program. Each property was evaluated to determine whether adequate sampling had been previously conducted to evaluate the potential presence of Raymark waste. Both EPA and the CT DEP (the Agencies) participated in these evaluations.

Specifically, if adequate shallow (0-2 feet) and depth (>2 feet) samples had been collected, then an assessment for the presence of Raymark waste was made based on a comparison of the sampling results to the definition of Raymark waste described in Section 2.2. If Raymark waste was identified on the property (that is, if the sampling results met the definition of Raymark waste), then the property was included in the Raymark Operable Unit No. 6 Remedial Investigation Report (OU6 RI[2]). If Raymark waste was not identified, then the property was "out"[3] of the evaluation process and no further action would be needed under Superfund.

If only shallow samples were collected or if no shallow or depth samples had been collected, the Agencies, with input from the town, reviewed the property to determine the potential for Raymark waste to be present in soil on the property. The Agencies'[4] determination of whether or not there was a potential for Raymark waste to be present on a property was based upon a

* Footnotes in Sections 2.1 and 2.2 reflect points of decisions as shown on Figures 2-1 and 2-2 for identifying Raymark waste.

number of factors. These factors included, without limitation, input from town officials (Town of Stratford, 2002/2003), evidence of past filling/disposal activities and locations, property conditions and topography, analytical data, aerial photography, proximity to the former Raymark Facility, proximity to areas subject to excavation by EPA's Removal Program, and evaluations and recommendations made by the federal Agency for Toxic Substances and Disease Registry (ATSDR) and/or the Connecticut Department of Public Health (CT DPH). Further, if a property abutted another property that had either been subject to an EPA removal action or was determined to contain Raymark waste, then that property usually was recommended for shallow and depth sampling, particularly if the Raymark waste portion of the removal property abutted it.

If the Agencies determined that there was not a potential for Raymark waste to be present on a property, then the property was considered "out" of the evaluation process and not part of the OU6 RI. If the Agencies determined there was a potential for Raymark waste to be present or if the evidence was inconclusive, then additional sampling was recommended[5]. At the conclusion of such sampling, analytical results were compared to the definition of Raymark waste. If Raymark waste was identified on a property, then the property was included in the OU6 RI. If Raymark waste was not identified on a property, the property was considered "out" of the evaluation process and no further action would be performed under Superfund.

2.2 Definition of Raymark Waste

All determinations of the presence or absence of Raymark waste (Raymark Waste Identified[6]) were based on the following definition of Raymark waste: Raymark waste in soil is defined as a single soil sample at the same depth interval containing lead above 400 parts per million (ppm) (milligrams per kilogram (mg/kg)) **and** asbestos (chrysotile only) greater than 1 percent **and either** copper above 288 ppm (mg/kg) **or** polychlorinated biphenyls (PCBs)(Aroclor 1268 only) above 1 ppm (mg/kg). This definition was developed by EPA, in consultation with the CTDEP, and reviewed by the Raymark Advisory Committee's consultant, prior to an evaluation of sampling data from the properties.

Properties that have soil samples with analytical results meeting the Raymark waste definition, and that have not undergone a removal action, or are not included under other operable units

as discussed in Section 1.3.3, are presented in this RI Report. A list of these properties is shown on Table 1-1. A Human Health Risk Assessment (HHRA) was performed to estimate potential current and/or future risks to the public from the contaminants detected in soils at each property containing Raymark waste. The results of these evaluations are presented for each property in Section 3.

As shown on Figure 2-2, details of the development of the Raymark waste definition are as follows:

1. **Lead** - Lead was selected as an identifying contaminant of Raymark waste as it was used in the fabrication of various brake and friction materials in the Raymark manufacturing process. Raymark acknowledged in its RCRA "Part A application" that up to 2.5 billion gallons of lead-contaminated waste liquid flowed through its on-site lagoons on an annual basis. The on-site lagoons were routinely dredged and the spoils were disposed of on the facility property and at other locations throughout the town. The soils and sediments on the former Raymark Facility, in particular the on-site lagoons, contained high levels of lead.

   Lead was identified as a contaminant of concern because it appeared in most samples collected during the 1992 – 1994 sampling on the former Raymark Facility (elevated lead concentrations were found in process waste, imported fill, and native fill – the latter two assumed to be the result of leachate or cross contamination).

   In addition, based on the samples collected on the former Raymark Facility and during the 1993 to 1995 removal actions, 400 mg/kg lead was selected by EPA and approved by ATSDR as a conservative permanently protective cleanup level for residential properties. This value was consistent with EPA's 1992 draft *Soil Screening Level Guidance and Revised Interim Soil Lead Guidance* document (EPA, 1992c). This document was later published in July 1994 as *Revised Interim Guidance on Establishing Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities* (EPA, 1994b). This value was also consistent with the sample data obtained from the former Raymark Facility itself.

Currently, the 400 mg/kg lead standard remains because it meets the new proposed Connecticut Remediation Standard Regulations (CT RSRs) for residential properties. In an effort to differentiate this contaminant from lead paint from a home or business, the presence of lead and asbestos in the same sample will further identify it as Raymark waste.

2. **Asbestos** - Asbestos was selected as an identifying contaminant of Raymark waste by EPA in 1993 because of its dominance in the waste materials from the 1993 to 1995 removal actions and from samples collected at the former Raymark Facility. The one percent definition was set because it meets the National Emission Standards for Hazardous Air Pollutants (NESHAP) definition for an asbestos-containing material (EPA, 1990a). Currently, the Raymark waste definition remains at one percent, identifying the asbestos as chrysotile asbestos. Chrysotile asbestos was selected as the specific asbestos of concern due to its dominance in the samples collected at the former Raymark Facility. From the hundreds of samples collected at the former Raymark Facility, chrysotile asbestos was the only form of asbestos identified.

3. **PCBs** – PCBs were selected as an identifying contaminant of Raymark waste because of their predominance in samples collected at the former Raymark Facility and given that PCBs do not occur naturally in the environment. A concentration of 1 mg/kg total PCB was adopted by EPA for use in previous removal actions since unrestricted exposure to 1 mg/kg or less of total PCBs has been deemed safe by EPA (OSWER Directive: *Remedial Actions for Superfund Sites with PCB Contamination*) (EPA, 1990b). Based on historical sampling, EPA further believes that the majority of PCBs at the former Raymark Facility resemble Aroclor 1268 rather than the other PCB Aroclors (including Aroclor 1262 which was also found consistently at the Raymark Facility). As such, EPA has refined the definition of Raymark waste from the general term “total PCBs” to the more descriptive term “Aroclor 1268” as noted below. Samples collected at the former Raymark Facility, and during the 1993 to 1995 removal actions, indicated that PCBs were contained in the waste materials. Using this information, PCBs were selected as an identifying contaminant of Raymark waste. In 1993, the 1 mg/kg total PCB standard was

selected based on the OSWER directive from August 1990, *Remedial Actions for Superfund Sites with PCB Contamination* (EPA, 1990b). Pursuant to this guidance, samples from properties collected from 1993 to 1995 with PCBs greater than 1 mg/kg were considered above the action level that is protective of human health in a residential exposure scenario without institutional controls.

Currently, the definition of Raymark waste has been refined to state that the PCBs action level is greater than 1 mg/kg Aroclor 1268, for the reasons described below. Aroclor 1262 was dismissed because it was not considered exclusively unique to the former Raymark Facility samples.

- Wipe samples, taken within the former Raymark Facility buildings that contained processes that most likely used PCBs, had Aroclor 1268.

- Samples collected by former Raymark Facility consultants, from the sediments and soils on the facility property where off-specification process waste was dumped to fill in low spots on the property, contained Aroclor 1268.

- Knowledge that PCB usage was probable in manufacturing processes such as Raymark's (plasticizers in phenolic resins and as wax extenders).

- No other known users of 1268 Aroclors have been identified in the area (either to jointly dump materials on the properties throughout Stratford and/or to provide disposal materials to Raymark as imported fill material. EPA assumes that any fill materials brought onto the Raymark property would have been from local sources as a cost savings to the company).

- Samples taken from known Raymark waste disposal areas around Stratford over the past 10 years contained Aroclor 1268.

4. **Copper** - Copper was selected as an identifying contaminant because of its predominance in the Raymark waste from samples collected from the 1993 to 1995 removal actions, and the former Raymark Facility. The 288 mg/kg standard was selected by EPA as the identifying benchmark as it is ten times greater than average background concentrations (see Table 2-2).

2.3 Raymark Waste Area

Based on the Raymark waste definition identified above, EPA, in consultation with the CT DEP and review by the Raymark Advisory Committee consultant, calculated the area of Raymark waste at each property. These areas are shown on the respective Section 3 figures for each property (Figures 3-1 through 3-24) as the "Estimated Area of Raymark Waste" and are presented in both square feet and acres for all properties on Table 1-1. The area of Raymark waste defines the portion of each property for which risks to human health have been estimated. Exposures are prorated based on the proportion of the property containing the Raymark waste (see Section 2.7). Areas of each property that are outside of the defined Raymark waste area may also contain contamination (see discussion provided for each property in Section 3). Some of the contamination outside the defined Raymark waste area may even exceed safe levels established by the state or federal governments. However, because these areas do not meet the definition of Raymark waste, they are not evaluated for risk effects within this document. Information on all contaminants both within and outside the estimated area of Raymark waste are described in both Section 2.7 and for individual properties in Section 3.

The following steps were used to determine the estimated lateral extent of Raymark waste for each property, shown as the gray areas on the figures in Section 3.

- All of the soil sample analytical data available from the property were assembled in a database.

- The database was queried to display soil sampling data for Raymark waste constituents (lead, asbestos, Aroclor 1268, and copper).

- The analytical data for each soil sample were evaluated to determine which sample locations met the Raymark waste definition.

- Every sample location for which data were available was shown on a map of the property.

- Sample locations where Raymark waste was present were noted.

- At each sample location containing Raymark waste, the halfway point between the location and any adjacent sample locations that did not contain Raymark waste was measured and noted.

- After all of the halfway points had been noted, the midpoints were connected and an assumed limit to Raymark waste for the property was developed.

- Raymark waste limits, without regard to on-site buildings, were drawn.

- After preliminary lines were drawn, the building footprints were subtracted and the Raymark waste lines were redrawn around the perimeter of each building so as to exclude the areas beneath buildings.

Some of the limitations of the method used to determine the Raymark waste areas are noted below; however, this is not a comprehensive list of limitations:

1. Assuming that all data were valid and complete, the accuracy of lateral extent lines was partially a function of the density of sample points on a particular property. The existence of a sparse or irregular distribution of sample points tended to assign greater significance to those sample points over other points that were located within an area that was densely populated with sample points.

2. Soil samples were evaluated without regard to the depth from which the soil sample was collected.

3. If a soil sample did not meet the Raymark waste definition as described under Section 2.2, then it was not considered Raymark waste. This limitation has ramifications for future estimates of Raymark waste or actual measurements of Raymark waste during implementation of a remedial action. Two examples of the limitations of the data are as follows. First, if a soil sample satisfies two of the four Raymark waste criteria (i.e. lead and asbestos), but no data exists to determine whether it satisfies the third or fourth criteria (i.e. PCB and copper), the soil sample was not considered to be Raymark waste. Second, if a soil sample did not satisfy the criteria for Raymark waste, but came close (i.e. lead=390 ppm), it was not considered Raymark waste. Please note that areas not comprehensively sampled for identification of Raymark waste may be re-sampled and characterized during the pre-design and design stages of the Superfund remedial action.

4. The analytical data that were used to perform this evaluation were collected as much as 10 years ago. It is possible that contaminant migration has impacted the characteristics of the soil at these locations, and that a sample collected today from the same location may have different contaminant characteristics.

5. The analytical results were compared to the Raymark waste criteria definition without consideration of the accuracy and precision of the analytical method used. For most of the soil samples, x-ray fluorescence (XRF) screening was performed for lead and copper and gas chromatograph with electron capture detection (GC/ECD) screening was performed for PCBs as Aroclors. Confirmatory samples were sent for laboratory analysis of lead, copper, and PCBs using EPA-approved methods. When screening and confirmatory results were available for one sample, the confirmatory results were used.

Once the assumed lateral extent line was drawn onto a map of the property, AutoCAD was used to measure the area of Raymark waste. The area of Raymark waste for each property is presented on Table 1-1. Only Raymark waste that was located within the property boundary was included in the total surface area for a particular property; Raymark waste located off the property may be indicated on the figure, but is not included in the surface area totals for that property. Where relevant, it is included in the evaluation for the abutting property where

Raymark waste was found within its borders. The buildings were deleted from calculations of the estimated area of Raymark waste (as shown on Table 1-1).

2.4 Physical Characteristics of the OU6 Study Area

This section describes the physical characteristics of the OU6 study area and the region in which the study area is situated. The surface features and land uses are described in Section 2.4.1; surface geology and fill materials are presented in Section 2.4.2; and discussions of climate are presented in Section 2.4.3. Throughout this report, all elevations are stated in feet with respect to the National Geodetic Vertical Datum (NGVD), 1929.

2.4.1 Surface Features and Land Use

Most of the 24 properties are part of the Housatonic River Basin, a tidally influenced system. The study area includes residential, recreational, and commercial properties. The study area is described in Section 1.3.2 and shown on Figure 1-2.

The topography of the majority of the study area is relatively flat, with gentle slopes to Ferry Creek and the Housatonic River. Based on a review of USGS topographic maps, the majority of the study area lies at topographic elevations of approximately 10 feet. The commercial properties to the north in the vicinity of East Main Street are higher in elevation.

Seven of the 24 properties are outside the 100-year flood plain. Most properties within the study area are located entirely or partially within the 100-year floodplain, as observed from Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps for Stratford, Connecticut (FEMA, 1992). The 100-year frequency base flood elevation is 10.1 feet; the 10-year frequency flood elevation is 8.5 feet (USACE, 1998).

State- or federally-listed threatened species reported to exist in the vicinity of the study area include the least tern, the atlantic sturgeon, and occasional transient bald eagles and peregrine falcons (NOAA, 1998; CT DEP, 1997a; US DOI, 1997).

The Town of Stratford is located in southwestern Connecticut on the shore of the Long Island Sound between Bridgeport and the Housatonic River. There are two public beaches, five marinas, several fishing piers, and two boat launching areas. The principal industries within the Stratford community include manufacturing of aircraft, air conditioning, chemicals, plastic, paper, rubber goods, electrical and machine parts, and toys. There are approximately 2,200 business establishments in Stratford. The Stratford, Connecticut web page (www.townofstratford.com) states the 2003 population of the Town of Stratford as 49,389 people within the 18.7 square miles of the town.

2.4.2 Surficial Geology

The surficial deposits of the study area are mapped as Stratford outwash sediments, fill deposits, and swamp/marsh deposits (Flint, 1968). Based on borings advanced in or near the study area, the surficial deposits are characterized primarily as a variety of locally derived glacial outwash deposits and ice contact deposits, alluvial deposits, swamp and marsh deposits, and fill materials. Glacial till may be present locally. Overburden consists of a complex sequence of alluvial and outwash deposits (sand and gravel) ranging from silty sands to coarse gravels. Peat/organic silt deposits are common in the study area, frequently underlying fill materials.

Fill consists of a mixture of natural and man-made materials. Fill materials frequently include manufacturing, household, and construction debris usually mixed with natural materials such as silty sand and gravel. Natural materials include various amounts of clay, silt, sand, and gravel. Man-made materials consist of charcoal, asphalt, metal, brick, tile, glass, and other miscellaneous materials, including manufacturing debris. Other fill materials that do not contain visual evidence of man-made debris are present throughout the study area, generally consisting of sands with varying amounts of silt and gravel. This fill is frequently more difficult to distinguish from natural/native deposits. Specific information on the presence or absence of artificial fill materials and contaminated soil intervals was reviewed from the boring logs. Fill was identified based on visual descriptions of soil and sediment samples collected during the field investigations.

Historically, fill originating from the former Raymark Facility has been described as a generally black fine-grained material often containing visible asbestos-containing materials. For the purposes of this report, Raymark waste is defined by its chemical composition as described in Section 2.2. Boring logs are included in Appendix A.

2.4.3 Climate

The study area is located in a temperate-humid climate, characterized by highly changeable weather and large daily and annual temperature variations. The most pronounced topographical effect is the land-sea breeze, an occurrence generally associated with the spring through early autumn months. General temperatures during the summer months average 3 to 5 degrees lower than nearby inland locations. Temperatures during the fall and winter months are moderated because of the proximity of Long Island Sound. Winter snowfall is generally around 10 inches less than areas a few miles inland, also due to the proximity to Long Island Sound.

The local National Oceanic and Atmospheric Administration (NOAA) Climatological Station is located in Stratford, Connecticut at the Bridgeport-Sikorsky Airport. For the past 30 years, data from this station have been used to describe the general climate in the area.

July is the warmest month with an average temperature of 74° F. The coldest month is January with an average temperature of 29.9° F. The maximum temperature observed between 1939 and 1998 was 103° F. The minimum temperature observed during this period was -7° F. Normal annual precipitation for the region is 44.2 inches, with between 3 and 4 inches of rain or water equivalent falling during each month. The area has an average annual snowfall of 25.8 inches which generally occurs between November and April. However, most snowfall occurs in January and February. Averages for these months are 7.4 inches and 7.6 inches, respectively.

Wind speed in the region varies between 9.3 and 13.0 miles per hour (mph) with an average of 11.4 mph. In the warmer months the prevailing wind direction is southwest. In the colder months the prevailing direction is west to northwest (NOAA, 2002).

2.5 Nature and Extent of Contamination – General Approach

This section presents the approach used to characterize the analytical results of samples collected within the OU6 study area to determine the portion of each property that contains Raymark waste. Samples were analyzed to determine the presence or absence of Raymark waste, based on meeting the Raymark waste definition discussed in Section 2.2. A brief discussion of the potential sources of contamination affecting the study area is provided in Section 2.5.1. Section 2.5.2 provides an overview of the contaminants detected. Section 2.5.3 provides a discussion of the background concentrations developed for comparison with the study area concentrations. Section 2.5.4 provides a discussion of how the soil analytical results were evaluated. Summaries of the nature and extent of contamination detected at each of the 24 properties are provided in Sections 3.1 through 3.24. Analytical data used in the evaluation of the nature and extent of contamination can be found in Appendix C. Table 2-1 contains a list of chemical compounds that were used or handled at the Raymark Facility during its operation.

The solid matrix samples from the study area have been divided into soils and wetland soils. Soils are defined as solid matrix samples collected from relatively dry areas located outside designated wetland boundaries and not associated with creeks, creek beds, or the Housatonic River. Wetland soils are defined as solid matrix samples collected from within designated wetland boundaries. It should be noted that these samples may have been designated as either soils or sediments in previous investigations. For the purposes of this report, soils and wetland soils are the same and will be evaluated using the same criteria from the CT RSRs.

2.5.1 Potential Sources of Contamination

The contamination sources in the study area include locations where Raymark waste materials were disposed of (dumped) at residential and commercial properties within or adjacent to the OU6 study area, locations where erosion and/or leaching of the Raymark waste materials is (or was) occurring, and locations where contaminated groundwater discharged to Ferry Creek. The gray areas on the Section 3 figures illustrate the random nature of the Raymark waste disposal practices.

2.5.2 Overview of Chemical Compounds Detected

Brief descriptions of the major classes of chemical contaminants detected in the soils of the former Raymark Facility and the common industrial uses of these chemicals are presented in Sections 2.5.2.1 to 2.5.2.7. Section 2.5.2.8 provides a reference for the specific chemicals known to have been stored, handled, and/or used at the former Raymark Facility during its operation that may have contributed to contamination of the properties within the OU6 study area. An evaluation of the usability of field screening data is included in Section 2.5.2.9. This information provides a reference framework for the chemicals identified in the soils of the 24 properties included in this RI.

2.5.2.1 Volatile Organic Compounds (VOCs)

The VOCs detected in soil samples collected from the former Raymark Facility can be separated into three major groups: chlorinated hydrocarbons, aromatic hydrocarbons, and ketones. Many of these VOCs are organic solvents commonly used in industrial processes for degreasing parts; to prepare metal surfaces prior to painting, coating, or bonding; as constituents of paint thinners and resins; and to extract organic compounds from materials. Additionally, some of the detected VOCs are common components of gasoline and petroleum fuels.

2.5.2.2 Semi-volatile Organic Compounds (SVOCs)

The SVOCs detected in soil samples collected from the former Raymark Facility can be separated into three major groups: phenolic compounds, polynuclear aromatic hydrocarbons (PAHs), and phthalates. SVOCs are common constituents of various industrial products. Phenolic compounds are typically associated with fuels, coal, and petroleum products, and are used in manufacturing friction materials. PAHs are common components of coal tar (bitumen and asphaltic tars), petroleum products (motor and fuel oil), and combustion by-products. Phthalates are typically used as plasticizers in the manufacture of synthetic materials. Phenolic resins were used by Raymark Industries, Inc. in manufacturing friction materials.

2.5.2.3 Pesticides

Pesticides are typically used to control unwanted insects in residential and commercial areas, as well as to prevent crop destruction in agricultural settings. Pesticide formulations may include chlorinated and organophosphorous varieties.

During the operation of the former Raymark Facility, a large portion of the property consisted of vegetated areas. Pesticides may have been used at the former Raymark Facility to control unwanted insect populations. Various types of formulations could have been used, including chlorinated and organophosphorous pesticides. While these chemicals may have been applied at the former Raymark Facility, no documentation of their use has been identified. However, pesticides were identified in the soils on the former Raymark Facility and in the Raymark waste materials on properties excavated during EPA removal actions.

2.5.2.4 Polychlorinated Biphenyls (PCBs)

The PCBs detected in the soil samples collected from the former Raymark Facility consisted solely of Aroclor 1262 and Aroclor 1268. PCBs are extremely stable chemicals with a wide range of physical properties. They have been historically used in plasticizers, adhesives, lubricants, heat transfer fluids, and as dielectric fluids in transformers and capacitors. Aroclor 1262 and Aroclor 1268, specifically, are used as plasticizers in synthetic resins. Aroclor 1268 is also commonly used as a wax extender and plasticizer in rubbers.

No information on PCB usage has been provided directly by Raymark Industries, Inc. documenting the specific use of PCBs as part of their manufacturing process. However, the use of PCBs in the manufacturing of brake linings is documented in the literature. The Raymark Facility was also known as having used and/or manufactured both rubber (gasket materials) and resins (phenolic resins in brake linings). It is assumed that Aroclor 1262 and Aroclor 1268 were used as plasticizers in these materials. Samples containing Aroclors 1262 and 1268 were obtained at the former Raymark Facility. Section 2.2 details the results of this sampling and the linkage to the identification of Raymark waste.

2.5.2.5 Dioxins and Furans

Soil samples from the former Raymark Facility contained detectable concentrations of dioxins and furans. Dioxins and furans are not manufactured commercially. Chlorinated dioxins and furans are formed during the production of chlorinated compounds (such as PCBs, herbicides, pesticides, and chlorophenols), or as a result of incomplete combustion of chlorinated chemical compounds (such as PCBs). The term “dioxins” is commonly used to refer to a specific group of polychlorinated dibenzo-p-dioxin chemical compounds. The toxicity of one specific compound, 2,3,7,8-tetrachloro-dibenzo-p-dioxin (2,3,7,8-TCDD), has been studied more than other known dioxins and furans. The toxicities of all other dioxins and furans are expressed in relation to 2,3,7,8-TCDD. Concentrations of each individual dioxin and furan in a sample are multiplied by Toxicity Equivalent Factors (TEFs) to yield 2,3,7,8-TCDD equivalent concentrations. These values are then totaled to yield total dioxin Toxicity Equivalent (TEQ) concentrations.

2.5.2.6 Metals

Numerous metals were detected in the soil samples collected from the former Raymark Facility. Some metals are naturally occurring components of soil and/or localized mineral deposits, or are the result of decomposition of weathered bedrock. Metals may also be introduced into the environment through various industrial activities including disposal of waste materials or process sludges, and fugitive emissions from various thermal or combustion processes.

Barium, copper, lead, and zinc were the primary metals used at the Raymark Facility to fabricate various brake and friction materials. Each of these metals was detected at elevated concentrations on the former Raymark Facility. Section 2.2 details the results of this sampling and the linkage to the identification of Raymark waste.

2.5.2.7 Asbestos

Asbestos was detected in soil samples collected from the former Raymark Facility. Asbestos is a group of magnesium silicate minerals that contain varying quantities of iron and calcium

silicates. Because of its non-combustible and heat-resistant properties, asbestos was commonly used to manufacture brake linings, gaskets, fireproof fabrics, roofing materials, and electrical and heat insulation, and as a reinforcing agent in rubber and plastics.

Asbestos-containing materials were the primary components in the products manufactured at the former Raymark Facility. Asbestos fibers were mixed with phenolic resins to manufacture brake pads and linings. Asbestos was also used to manufacture friction materials (clutches and transmission plates) and gaskets. Chrysotile was the form of asbestos used at the Raymark Facility. Samples containing asbestos were obtained at the former Raymark Facility. Section 2.2 details the results of this sampling and the linkage to the identification of Raymark waste.

2.5.2.8 Chemical Compounds Used or Handled at the Raymark Facility

A number of chemical compounds and materials were handled, stored, and/or used in manufacturing processes at the former Raymark Facility during its operation. A list of these chemicals, presented in Table 2-1, was developed from information provided in the *RCRA Facility Investigation Report* (ELI, 1995) and the facility's RCRA Part A application (August 15, 1980). No Part B application was ever formally filed for the Facility, so specific information on the operation of the former Raymark Facility is unavailable.

2.5.2.9 Evaluation of Usability of Data

The soil samples collected over the past 10 years to determine if wastes associated with the former Raymark Facility and environs had impacted a property were analyzed using screening techniques and/or by a fixed laboratory using EPA-approved methods. An evaluation of the results of both analytical procedures was conducted to determine whether the results could be used interchangeably for both the identification of the nature and extent of contamination and the human health risk assessment. All asbestos data are considered useable.

The lead, copper, and PCB screening data were evaluated by statistical analysis (linear regression) to determine a potential correlation between the screening data and the results by EPA-approved methods. The linear regression analysis involved a point-by-point comparison

of the data generated by the two methods. The correlation results are presented in Appendix B-3.

The results of the statistical analysis indicated that the screening data collected for copper and lead could be used with the same level of confidence as the data from the EPA-approved methods. A poor correlation was found between the PCB screening and EPA-approved method data. EPA, therefore, deemed the copper and lead screening data acceptable for use quantitatively in the RI and risk assessment and the PCB screening data acceptable for use quantitatively only in determining the nature and extent of contamination. PCB screening data were used in the risk assessment only for discussion in the absence of EPA-approved method data (B&RE, 1997b and 1997c). The screening results were used to provide real-time data necessary to make site decisions about the presence or absence of Raymark waste on the properties sampled, and whether the sample contained lead, copper, asbestos, or Aroclor 1268 at concentrations above or below the Raymark-waste definition benchmarks.

2.5.3 Background Concentrations

As part of the investigation activities conducted by EPA, soil samples were collected from schools, day care centers, and recreational areas around the Town of Stratford. The samples were analyzed for pesticides, PCBs, and metals. Metals results from 34 of 39 sample locations, and pesticides and PCB results from 27 of 37 sample locations, were determined to be representative of background conditions. Because of variability in the analytical data and/or heterogeneity of the samples, average background soil concentrations were developed by averaging the numerical data from samples deemed representative of background conditions. The numerical averages were calculated as the arithmetic average of the detected concentrations and half the detection limits for those compounds/analytes reported as undetected. The average background concentrations for pesticides, PCBs, and metals in soils are presented in Table 2-2. No background soil samples were analyzed for VOCs, SVOCs, dioxins, or furans.

2.5.4 Approach for Evaluating Analytical Results

For purposes of evaluating the nature and extent of contamination, contaminants were compared to the CT RSRs, Regulations of Connecticut State Agencies Section 22a-133k-2, Standards for Soil Remediation (CT DEP, 1996); Pollutant Mobility Criteria (CT PMC) for GB Aquifers, and Direct Exposure Criteria (CT DEC) for soils. Six properties including one residential property, one potential future residential property, one easement across residential property, and three recreational properties, were compared to the CT DEC for residential soils and 20 properties were compared to CT DEC for industrial soils. (Note that two properties were compared to the CT DEC for both residential and industrial soils).

2.5.4.1 Criteria for Identification of Contaminated Soils

Asbestos-containing material is defined in 40 CFR 61 Subpart M, as material containing more than 1 percent asbestos. For purposes of this report, greater than 1 percent asbestos was used to evaluate the presence or absence of asbestos. In Tables 3-1 through 3-24, the greater than 1 percent criterion for asbestos is included on the tables. However, CT DEP does not have a criterion for asbestos in soils. To evaluate the soil analytical results for other contaminants, the CT DEC were used as screening values to help identify contaminants that may pose threats to human health through direct contact with soils. In the case of metals and PCBs, comparisons were made to the Synthetic Precipitation Leaching Procedure (SPLP) or Toxicity Characteristic Leaching Procedure (TCLP) results, if available, for comparison. CT DECs are regulatory criteria for soil based predominantly on risk from exposures via the ingestion pathway with consideration given to state-determined background concentrations, detection limits, and state-determined ceiling limits. These ceiling limits are maximum concentrations at which a criteria will be set and are generally used for chemicals of very low toxicity.

2.5.4.2 Criteria for Identification of Potential Groundwater Protection Concerns

An evaluation of groundwater is not part of the scope of work for this RI, but will be addressed as part of an area-wide groundwater assessment in the RI report being prepared for OU2. However, a preliminary qualitative assessment of the potential for chemical migration from

soils to groundwater was conducted as part of this RI based on a comparison of maximum chemical concentrations detected in soil to the CT PMC for GB aquifers. CT PMCs are regulatory criteria for soil based on ambient water quality criteria and modeling the migration of contaminants from soil to groundwater. The comparison allows a preliminary evaluation of the chemicals' potential to migrate to groundwater and potentially impact the quality of groundwater.

Under the CT RSRs (CT DEP, 1996), concerns regarding the leachability of inorganics and PCBs are addressed using TCLP and/or SPLP data. A comparison of property-specific TCLP or SPLP data to CT RSRs for pollutant mobility is provided in Tables 3-1 through 3-24, as appropriate.

The nature and extent of contamination in the soils on a property are presented separately for each of the 24 properties. Summary statistics and a comparison to available benchmarks, described above, are presented in a table for each property in Section 3. In addition, a figure depicting sample locations and identification of Raymark waste areas, and exceedances of CT RSRs, is also provided for each property.

2.6 Contaminant Fate and Transport – General Approach

Fate and transport of contaminants are determined by a variety of factors. The physical and chemical properties of the contaminants and the medium (i.e., soil, groundwater, surface water, air) to which the contaminants are released are all factors that determine the eventual fate of these chemicals. In the study area, the combination of on- and offsite-related contaminants, geologic and hydrogeologic conditions, and surface features influence how contaminated site soils may have migrated into other environmental media (i.e., the underlying groundwater, surface water bodies, and sediments). The contaminant fate and transport in this OU6 RI Report is a qualitative assessment for each property; additional information and field measurements would be required to provide quantitative analyses. A discussion of the fate and transport of contaminants on each of the 24 properties is presented in Section 3.

The Raymark waste used as fill contains VOCs, SVOCs, PCBs, pesticides, dioxins and furans, metals (primarily lead and copper), and asbestos. As discussed in Section 2.4.2, the fill is a

mixture of natural and man-made materials. Natural fill consists of clay, silt, sand, and gravel. Man-made materials consist of charcoal, asphalt, metal, brick, tile, glass, and other miscellaneous man-made materials, including manufacturing debris. Raymark waste (comprised of sludges excavated or dredged from the lagoons, "off-specification" materials that were discarded, and other waste products) was disposed of as fill material throughout the study area, and contamination of many of the properties included in this RI occurred as a result of that filling.

There is also a potential for contaminants to have been released onto a property from other commercial and industrial operations or from groundwater contamination identified in the OU2 Groundwater RI. Past releases of petroleum hydrocarbons, VOCs, SVOCs, and other contaminants from other sources are likely, based on the long history of industrial and commercial activities in the area. Process water and runoff from the Raymark Facility containing these contaminants were directly discharged to Ferry Creek, which runs through the study area. The origins of some of the chemical contamination affecting the properties are indistinguishable. Identifying these potential other sources is not within the scope of this report. However, they will be considered during the evaluation of potential remedies.

Based upon available information, the two primary sources of contaminants at the 24 properties discussed in this report are:

- Disposal of contaminated Raymark wastes, including sludges from the former Raymark Facility lagoons, which were used to fill in low topographic areas. These fill materials have become sources of further contaminant releases to the wetlands, Ferry Creek, the Housatonic River, and other topographically low-lying areas.

- Spills, leaks, and other releases that may have occurred at the property as a result of past storage, usage, or disposal of chemicals and other substances.

There are three primary mechanisms by which contamination from the estimated area of Raymark waste can enter into other environmental media:

- Contaminants in the fill can leach to subsurface soils;

- Erosion and surface runoff can carry contaminated soils into Ferry Creek, Bruce Brook, and the Housatonic River; and

- Contaminants can leach into the groundwater, migrate through advection, and discharge into Ferry Creek, Bruce Brook, or the Housatonic River as baseflow.

The evaluations of contaminant fate and transport in this RI are based on existing property conditions, identification of chemicals present in the environmental media, the physical state of soil and groundwater contaminants, general fate and transport mechanisms, and the interpretation of geologic and hydrogeologic conditions within the study area.

On a property, the fate and transport processes of concern are those that govern the migration of soil contaminants (once released or deposited) to the surrounding environment. Once these contaminants have entered another medium, other fate and transport mechanisms occur that may cause further chemical migration or transformations. This generalized discussion of fate and transport processes is provided so that the observed property-specific contamination conditions presented in Section 3 can be better characterized and understood.

2.6.1 Fate and Transport of Contaminants in Soils

Once organic and inorganic contaminants are released to soils, a variety of processes occur that may cause them to become immobilized, degraded, or to be mobilized to another environmental medium. Some of these processes include:

- Volatilization – Chemicals having high Henry's Law coefficients or vapor pressures will readily enter (volatilize) to the ambient air rather than remain adsorbed to the soil particles. Once in the atmosphere, the chemicals may undergo further transport through additional processes such as advection, diffusion, or dispersion. The chemicals may also be transformed through chemical processes such as hydrolysis or photolysis. SVOCs, metals, PCBs, pesticides, dioxins, and asbestos are generally less volatile than VOCs or are nonvolatile. Therefore, only VOCs will be evaluated for migration into the ambient air.

- Leaching – Chemicals may be transported downward through the soil by water from precipitation or by liquids that infiltrate through the soils. The leaching of chemicals from soils and the subsequent mobilization are controlled by soil properties (i.e., adsorptive capacity, organic carbon content, clay content, or specific surface area) and by chemical properties (i.e., solubility, ability to partition to other phases). Leaching may occur directly when the contaminated soil is in direct contact with the groundwater.

- Runoff/Erosion – In situations where the chemicals remain adsorbed (bound) to soil particles because of the soil's chemical characteristics, chemicals may still be mobilized from contaminated areas to other uncontaminated environmental media. Contaminants can be conveyed over land by runoff that occurs during precipitation events (solubilized in rainwater or adsorbed to suspended particles), or through the erosion of contaminated soils that are present on unstable slopes or topographic features.

- Excavation/Human Activity – Soils can be mobilized during excavation by equipment, or digging by humans or animals. This may occur during on-site construction, renovation of the property, utility repairs, gardening, animal burrowing, etc. Contaminants may be conveyed into the air or into on-site piles allowing contact with humans.

The following paragraphs describe the general movement of contaminants in soils on the 24 properties:

VOC Fate and Transport in Soils - Based on current conditions at the properties, the migration of VOCs through volatilization and erosion runoff appears to be unlikely or limited, because of low VOC concentrations and low frequencies of detection. However, for properties abutting Ferry Creek, the Housatonic River, and Bruce Brook that have exposed stream banks, erosion could cause contaminated soils and fill materials to migrate and be deposited in the water channel.

SVOC Fate and Transport in Soils - Leaching of SVOCs appears to be limited because of their low water solubilities and the degree to which the majority of the properties are covered by pavement and buildings. Also, because SVOCs are typically less soluble than VOCs and are less likely to leach into the groundwater, their impact on groundwater quality is limited.

Erosion of SVOC-contaminated soils from runoff appears to be unlikely or limited because of the extent of paved or covered areas, and flat topography of the properties. For the properties abutting Ferry Creek, Bruce Brook, and the Housatonic River, erosion of the stream banks appears to be introducing some SVOCs into the sediments.

Fate and Transport of PCBs, Pesticides, Dioxins, and Asbestos in Soils - Review of soil, sediment, and groundwater analytical results, current site conditions for each property (ground cover/pavement, flat topography), and the relatively insoluble nature of these contaminants indicate migration through leaching is unlikely or limited. PCBs were detected in only one groundwater sample, and they may be present due to the elevated VOC level in this sample, which can cause the PCBs to be more soluble. An overall evaluation of groundwater contamination, including sample locations, analytical results and fate and transport is presented in the Draft Final OU2 RI (TtNUS, 2000c).

Property soils contaminated by PCBs, pesticides, dioxins, and asbestos are unlikely to be mobilizing into Ferry Creek, Bruce Brook, and the Housatonic River through erosion under current conditions because most ground surface areas are paved, covered, or vegetated. For the properties that abut Ferry Creek, erosion of the stream banks may be causing some PCBs, pesticides, dioxins, and asbestos to migrate into the stream channel.

Fate and Transport of Metals in Soils - Review of soil data, the groundwater analytical results, and current site conditions (ground cover/pavement, flat topography) indicates that metals, in particular, lead, can be mobilized through precipitation infiltration where soluble metal compounds are leached into the underlying soils and groundwater. To evaluate the leaching potential, soil metals concentrations were compared with the background metals levels and with the CT PMC. The CT PMC are defined as the allowable metal concentration in leachate resulting from designated leaching protocols. These protocols include the SPLP, EPA SW-846, Method 1312, or the TCLP, EPA SW-846, Method 1311. The SPLP and TCLP protocols are meant to simulate materials subjected to leaching by acid precipitation and are the accepted methods for evaluating the potential mobility of metals from soils and sediments. Several soil samples were tested under the SPLP protocol and the results are shown in Appendix C.

Erosion of metal-contaminated soils at the 24 properties due to runoff appears to be unlikely because most areas are covered by pavement and/or structures, have flat topography, or have vegetative ground cover or gravel (which decreases erosion). The stream banks at the properties abutting Ferry Creek, Bruce Brook, and the Housatonic River were observed to contain fill materials that were not stabilized (i.e., by rip rap or cover materials). Particularly for Ferry Creek, erosion of the stream banks appears to be contributing some contaminated materials into the Ferry Creek channel. Ferry Creek also received surface water and sediments from upstream sources (i.e., the Raymark Facility), which could have resulted in the deposition of metals in the stream sediments. This potential contaminant transport pathway is evaluated in the three OU3 RI reports (TtNUS 1999b, 2000a, 2000b).

Based on the available data, it is reasonable to conclude that soil contaminants present at the properties that abut Ferry Creek, Bruce Brook, or the Housatonic River, can migrate into surface waterbodies through groundwater transport and discharge, and through erosion of the stream banks. Contaminant transport from properties that do not abut a water source appears to be minimal. The evaluation of the contaminant extent and the likely fate and transport of these chemicals in Ferry Creek have already been investigated under the OU3 RI and the results are presented in the OU3 RI Reports (TtNUS, 1999b, 2000a, and 2000b).

2.7 Human Health Risk Assessment

This section presents the methodology for a baseline human health risk assessment (HHRA) conducted for estimated areas of Raymark waste within the study area described in Sections 1.3 and 2.1. Only the 24 properties with soil samples that meet the definition of Raymark waste, as described in Section 2.2, are included in this HHRA. Table 1-1 presents a listing of, and Figure 1-2 depicts, the OU6 properties. At each property the risk assessment addresses the risks associated with exposure to the portions of the property estimated to contain Raymark waste as shown in Figures 3-1 through 3-24. The objective of the HHRA is to estimate potential current and future risks to the public from the contaminants detected (the four Raymark waste indicator compounds and other contaminants) in the soil samples collected from within these estimated areas of Raymark waste. Each property is evaluated separately. Data collected from each property, but beyond the estimated areas of Raymark waste, while useful in the delineation of the extent of Raymark waste, is not included in this

risk evaluation. Three different types of quantitative evaluations were performed. Non-carcinogenic contaminants are evaluated through estimates of hazard indices. Carcinogenic contaminants are evaluated through estimates of cancer risk. Lead is evaluated through adult and child lead models, which predict blood lead levels. In addition, qualitative evaluations of potential inhalation risks from asbestos exposure are discussed. Soil exposures and resulting risk estimates have been prorated based on the percentages of each property estimated to contain Raymark waste (fraction of Raymark waste, FRW, as shown in Table 1-1 and discussed in Section 2.3). The use of the FRW to prorate exposures in calculations of risk assumes that receptors use all areas of the property on an equal basis. Prorating exposures recognizes that a receptor is unlikely to spend all of their time within the estimated areas of Raymark waste. Rather, a receptor will be exposed to soils from various areas of the property. By prorating the exposure, the resulting risk estimate represents risk from only the estimated areas of Raymark waste. Total risks associated with exposures to an entire property may be higher than presented in this HHRA if contaminants are present beyond the estimated areas of Raymark waste or if receptors spend a higher percentage of time in estimated areas of Raymark waste than that assumed in Table 1-1.

Section 2.7.1 provides an overview of the risk assessment process and a brief explanation of the relationship between the OU3 baseline risk assessments and OU6 baseline risk assessments. Risks identified for large contiguous areas in the OU3 RI provided the basis for further evaluation of individual properties under this OU6 RI. Sections 2.7.2 through 2.7.5 outline the methodology used to conduct the OU6 baseline HHRA. An analysis of the uncertainties associated with the risk assessment is presented in Section 2.7.6. Appendix B-1, Table 1 presents an overview of the various media, exposure points, potential receptors, and exposure pathways evaluated in this risk assessment. The property-specific results of the risk assessment are presented in Section 3. Section 4 presents a summary of the baseline HHRA. The risk assessment conducted for this report follows the most recent guidance from the EPA (EPA, 1989b and 1991a), including regional EPA guidance (EPA, 1989a, 1994c, 1995, 1996c, and 1999b). Tables were prepared following the standard format in accordance with Risk Assessment Guidance for Superfund, Human Health Risk Evaluation Manual (RAGS HHEM) Part D (EPA, 1997c). These tables are presented in Appendix B-1.

2.7.1 Overview of the Risk Assessment Process

The baseline HHRA for the OU6 properties estimates the magnitude of the potential human health risk resulting from exposures to the fraction of each individual property's soils identified as containing Raymark waste. A risk assessment provides the framework for developing risk information necessary to assist in determining the need for remediation at a site and developing potential remedial alternatives for a site. A baseline HHRA consists of five major components, as follows:

- Data evaluation and identification of chemicals of potential concern (COPCs);
- Exposure assessment;
- Toxicity assessment;
- Risk characterization; and
- Characterization of uncertainty in the risk estimates.

To assess potential public health risks, four major aspects of chemical contamination and exposure must be considered: contaminants with toxic characteristics must be found in environmental media; contaminants must be released by either natural processes or by human action; potential exposure points must exist; and human receptors must be present at the point of exposure. Risk is a function of both toxicity and exposure. If any one of the requirements listed above is absent for a specific site, the exposure route is regarded as incomplete and no potential risks will be considered for human receptors.

The baseline HHRA for the OU6 properties estimates the potential for human health risk from exposures to soils identified as Raymark waste at each of 24 properties shown in Figure 1-2. Table 1-1 presents a listing of the OU6 properties.

The data evaluation component of the HHRA is primarily concerned with selecting COPCs that are representative of the type and magnitude of potential human health effects. Both current and historical data are considered in developing a list of COPCs. In turn, these COPCs are used to evaluate potential risks. A generic discussion of the process is contained in Section 2.7.2, and property-specific discussions are presented in Section 3.

The exposure assessment identifies potential human exposure pathways at the study area under consideration. Exposure routes are identified based on information on study area chemical concentrations, chemical release mechanisms, human activity patterns, and other pertinent information to develop a conceptual site model. One overall set of exposure routes was developed for this report, but not all routes are applicable in all OU6 properties. A generic discussion of the exposure assessment is contained in Section 2.7.3. Section 2.7.3.1 presents the conceptual site model. Section 2.7.3.2 presents the potential routes of exposure. Section 2.7.3.3 presents potential human receptors and the relevant exposure assumptions. Section 2.7.3.4 presents exposure pathways and the equations for estimating chemical intake. The property-specific risk assessments (Section 3) present only those routes relevant to each property, and refer to Section 2.7.3 for the details on the estimation methods.

The toxicity assessment presents the available human health criteria for all the selected COPCs. This assessment is contained in Section 2.7.4; however the final lists of COPCs for each property are presented within the property-specific assessments in Section 3. This section is presented early to avoid repetition of the toxicity information in Section 3 because many COPCs are common to many of the properties. Quantitative toxicity indices are presented where they are available. A discussion of health effects and dose-response parameters such as Reference Doses (RfDs) and Cancer Slope Factors (CSFs) is presented for each COPC.

The risk characterization (Section 2.7.5) describes how the estimated intakes are combined with the toxicity information to estimate risks. The actual numerical results of this exercise are presented in the property-specific discussions in Section 3 of this report. General uncertainties associated with the risk assessment process are discussed qualitatively in Section 2.7.6. Uncertainties associated with a particular property are provided in the property-specific sections.

Baseline HHRAs have previously been performed under OU3 for many of the properties now included in OU6 (see Final Area I RI OU3, October 1999 (TtNUS, 1999b); Draft Final Area II RI OU3, November 2000 (TtNUS, 2000a); Draft Final Area III RI OU3, November 2000 (TtNUS, 2000b)). Risks identified in those documents provided the basis for further evaluation of individual properties under OU6. The OU3 risk assessments estimated the human health risk

potential for large contiguous areas for commercial or recreational land-use exposures. OU3 risks from recreational and trespasser exposures were less than the EPA level of concern. However, in several commercial areas, the OU3 risk assessments identified risk levels greater than EPA and CT DEP levels of concern. Those commercial areas and other commercial properties known or suspected to have received fill from the Raymark facility became the focus of OU6.

In the process of identifying properties that had received Raymark waste as fill, four non-commercial properties were identified that had not been evaluated adequately. These four properties described below were also included in the OU6 study area:

- Since Wooster Park is used primarily for recreational purposes and was not included in the OU3 risk assessment, this property was evaluated for recreational use in the OU6 HHRA. Since it abuts residential property, exposure assumptions consistent with frequent recreational use by adults and children were considered.

- While the Vacant Lot at Housatonic Avenue is currently vacant and is land-locked, it is zoned for residential land-use, therefore it was evaluated for future residential use.

- The residential Third Avenue Property was evaluated for residential use.

- The Beacon Point Area is a recreational area, which was previously evaluated under OU3. Since more data is now available for this parcel it was re-evaluated under OU6. This evaluation was for frequent recreational use.

Therefore, while this OU6 risk assessment focused mainly on commercial exposures to soil contaminants, the four properties listed above, used for residential or recreational purposes, were also included in the OU6 risk assessment.

2.7.2 Data Evaluation Methodology

Data evaluation is a property-specific task that uses a variety of information to determine which of the detected chemicals at a study area are most likely to present a risk to potential

receptors. The study area for each property was defined as the area known as the "estimated area of Raymark waste", in which samples meet the definition of Raymark waste as described in Section 2.2. Appendix B-2 provides lists of samples that lie within the estimated areas of Raymark waste at each property. It should be noted that whenever a single sample from a particular location met the definition of Raymark waste, all samples from that location to a depth of 15 feet below ground surface (bgs) were included in the list of samples. The end result of the qualitative selection process was a list of COPCs and representative exposure point concentrations for each medium. Exposure point concentrations (EPCs) are defined as the contaminant concentrations at the point of exposure. The methodology used to identify COPCs for the OU6 RI Report is provided in Section 2.7.2.1. The methodologies used to determine EPCs for the selected COPCs are presented in Section 2.7.2.2.

2.7.2.1 Selection of Chemicals of Potential Concern

COPCs for the baseline HHRA were limited to those chemicals that exceed a selection criterion. For this risk assessment, EPA Region IX risk-based criteria were used to reduce the number of chemicals and exposure routes considered in a risk assessment following EPA Region I guidance and direction. Region IX risk-based criteria are chemical concentrations based on a fixed level of risk from soil exposures through ingestion, dermal, and inhalation pathways. The premise of this screening step is that risk is typically dominated by a few chemicals and that, although dozens may actually be detected, many chemicals may contribute minimally to the total risk.

Maximum detected concentrations in the soils at the estimated areas of Raymark waste at each property were compared to the risk-based screening criteria. If the maximum concentration exceeded the federal screening criteria, that chemical was retained as a COPC for all exposure routes involving soils at that property. For example, if barium was retained for soil, this chemical was evaluated as a COPC for both ingestion and dermal exposure routes.

In general, all available validated data for all contaminants and unvalidated field-screening data for metals from all EPA historical investigations and the recent TtNUS sampling effort were used to identify COPCs for each study area. A list of samples included in the HHRA for each property is presented in Appendix B-2. The individual investigations presented in

Appendix D discuss sample collection, the field-screening methods, and fixed laboratory analysis by EPA Contract Laboratory Program (CLP) methods. Appendix B-3 presents a correlation study, comparing field-screening data to CLP data. The correlation study concluded that field-screening data for metals were comparable to CLP data. However, there was a poor correlation between field-screening data and CLP data for PCBs. This is not unexpected, since the analytical techniques used in the mobile laboratory for PCB analysis differ from the techniques used in fixed laboratories. Detection limits for PCBs vary greatly between the two sets of data. Field-screening data were collected for use in defining the estimated areas of Raymark waste and are useful for that purpose. As discussed in Appendix B-3, there is a good correlation between field-screening data and CLP data, if one considers only the question of whether or not concentrations of PCBs are above 1,000 µg/kg. For this reason, field-screening data for metals, but not PCBs, were included in this HHRA.

Analytical results qualified as rejected, "R", during the data validation process, were not considered because of their potential unreliability. Soil data collected from depths greater than 15 feet (the maximum assumed depth for potential human exposure during excavation/construction) were not used in the COPC selection process. Property-specific COPC summary screening tables are provided in Appendix B-1. The property-specific COPC selection results are discussed in Section 3.

Data evaluation and subsequent risk estimates for dioxins were evaluated through use of dioxin toxicity equivalents (TEQs). The Toxicity Equivalent Factors (TEFs), presented in Appendix B-4, were used to convert concentrations of individual dioxin and furan congeners to TEQs of 2,3,7,8-TCDD. Concentrations of individual dioxins and furans were multiplied by their TEFs to yield 2,3,7,8-TCDD equivalent concentrations. These values were then totaled to yield total dioxin TEQs for each sample. The TEQs could then be compared to the screening toxicity value for 2,3,7,8-TCDD in the COPC selection step. One-half of the detection limit for non-detected dioxin results was included along with positive results in the TEQ summation for each sample.

COPCs were selected based on Region IX risk-based criteria for direct exposure. Direct exposure COPCs are those chemicals detected at maximum concentrations in excess of the risk-based EPA Region IX COPC screening levels for soil contact; these criteria were

developed for the protection of direct human contact with soil. Only chemicals selected as COPCs based on comparisons to direct contact criteria were evaluated quantitatively in the HHRA. The criteria used to identify COPCs are presented in Appendix B-1, Tables 2.1 through 2.24. Property-specific data were also compared to CT RSRs for direct exposure and for groundwater protection, as shown in Tables 3-1 through 3-24, and discussed in the nature and extent portions of Section 3.

COPCs for soils were selected for each individual property for soil samples collected from depths of 0 to15 feet below ground surface (bgs), based on CT DEP's definition of accessible soils. This soil depth is used to account for soil to which residents, recreational visitors, or commercial workers may be potentially exposed, particularly in the future when soils currently located at depth may be brought to the surface during excavation or construction activities. For some properties, the maximum sample depths within the estimated areas of Raymark waste were less than 15 feet bgs due to site-specific field conditions at the time of sampling. At these properties, all available soil samples within the estimated areas of Raymark waste were included in the HHRA. Actual sample depths are presented for individual properties in the Section 3 risk discussions.

The following screening criteria were used to identify COPCs for direct contact exposure to soils:

EPA Region IX Preliminary Remedial Goals (PRGs) for Soil Exposures. PRG concentrations for soil contact for industrial land use were used as COPC selection criteria for commercial properties. PRG concentrations for soil contact for residential land use were used conservatively as COPC selection criteria for the four residential and/or recreational properties. These values were developed using the current EPA Region IX Preliminary Remedial Goals Table (EPA, 2002), which identifies concentrations of potential concern for nearly 600 chemicals in various media (air, drinking water, and soil) using certain reasonable maximum exposure default assumptions. The EPA Region IX industrial and residential soil exposure values were calculated based on the methodology presented in Risk Assessment Guidance for Superfund, Human Health Risk Evaluation Manual, Part B (USEPA 1991b) and consider the ingestion, dermal, and inhalation exposure pathways. For carcinogenic chemicals, the values used for COPC screening are based on a 1E-6 target incremental lifetime cancer risk. The

criteria for non-carcinogenic chemicals are based on a target hazard quotient (HQ) of 1.0. These EPA Region IX industrial and residential soil exposure values for non-carcinogenic chemicals were adjusted to COPC screening levels based on a target hazard quotient (HQ) of 0.1, which is one-tenth of the suggested cumulative target non-carcinogenic risk for a potential receptor. The estimation of cumulative target non-carcinogenic risks is described in greater detail in Section 2.7.5. Since EPA Region I does not advocate quantitative risk assessment of the health effects of aluminum, iron, cobalt, and copper, these EPA Region IX PRGs have been eliminated. The EPA Region IX PRGs for copper and iron are based on provisional oral RfDs. EPA Region I does not endorse their use because these provisional oral RfDs were based on concentrations needed to protect against a deficiency of the compound, rather than on quantitative estimates related to the hazard posed by overexposure (EPA, 1999b). Total chromium present was screened using the EPA Region IX PRG value for hexavalent chromium. The EPA Region IX PRG for hexavalent chromium was selected to be conservative in the absence of chromium speciation data. For PCBs, individual Aroclors were compared to screening criteria for individual Aroclors. All Aroclors were accepted as COPCs if at least one Aroclor was detected at maximum concentrations exceeding COPC screening levels.

EPA Soil Lead Guidance. EPA Region IX has developed residential PRG concentrations for lead, based on the EPA's Office of Solid Waste and Emergency Response (OSWER) soil screening level of 400 mg/kg for residential land use (EPA, 1994b). The EPA's Integrated Exposure Uptake and Biokinetic (IEUBK) model, which estimates the risk to a child resident, is the basis for this soil screening level. The lead screening level based on residential land use was used as a conservative approach for the five residential and/or recreational properties. EPA Region IX has developed industrial PRG concentrations for lead of 750 mg/kg, based on the EPA's Technical Review Workgroup for Lead model (EPA, 1996c and 1996d). The approach focuses on estimating fetal blood-lead concentrations in women exposed to lead contaminated soil in non-residential scenarios. The lead screening level based on industrial land use was used for the remaining commercial properties.

National Emission Standards for Hazardous Air Pollutants Benchmark for Asbestos. EPA Region IX has not developed risk-based concentrations for asbestos. Asbestos was a primary component of friction materials, e.g., gaskets material, sheet packing and friction materials, including clutch facing, transmission plates, and brake linings, manufactured at the former

Raymark Facility. Asbestos is considered a potential inhalation hazard. The National Emission Standards for Hazardous Air Pollutants (NESHAP) - EPA Regulation 40 CFR Part 61, Subpart M, Appendix A (EPA, 1990) defines asbestos as material containing more than 1 percent asbestos. Since asbestos was detected at the OU6 properties, the EPA's NESHAP benchmark of 1 percent for an asbestos screening value was used.

Background concentrations for chemicals in soil are presented in Table 2-2 and in Appendix B-1, Tables 2.1 through 2.24. Concentrations in the background soil samples were not used to select COPCs. A discussion of site data in comparison to the established inorganic and organic background levels is provided in the Section 3 uncertainty section for each property. Background concentrations will be considered when developing clean-up levels where an action is recommended.

Frequency of detection was not used as a COPC selection criterion. Essential nutrients, including calcium, magnesium, potassium, and sodium, were not selected as COPCs.

2.7.2.2 Exposure Point Concentrations (EPCs)

According to EPA regional guidance, risk assessments are conducted using an exposure point concentration for each COPC. The exposure point concentration is defined as the 95 percent upper confidence limit (UCL) on the mean and is calculated using the latest risk assessment guidance from EPA (EPA, 1992a, 1992b, and 1994c). A value of one-half the detection limit is substituted for non-detected values in the calculation of the 95 percent UCL on the mean. Because of potential problems with sample heterogeneity, the maximum detected concentration reported for field duplicate pair samples was used to calculate the soil matrix EPCs, at the direction of EPA. Sample lists for each property evaluated are provided in Appendix B-2.

The methodology used in the calculation of the 95 percent UCL on the mean depends on the distribution of the sample set. For this risk assessment, the distribution was determined using the Shapiro-Wilk W-Test (Gilbert, 1987). When the results of the test were inconclusive and the distribution was regarded as undefined, the distribution was assumed to be log normal and

the 95 percent UCL on the mean for log-normally distributed data sets was selected as the exposure point concentration.

For normally distributed data, the calculation of the 95 percent UCL on the mean is a two-step process. First the standard deviation of the sample set must be determined, as follows:

where: S = standard deviation

$$S = \left[\frac{\Sigma(X_i - \bar{X})^2}{(n-1)}\right]^{1/2}$$

X_i = individual sample value

n = number of samples

$\bar{X}$ = mean sample value

The one-sided 95 percent UCL on the mean is then calculated as follows:

$$UCL = \bar{X} + t\left(\frac{S}{n^{1/2}}\right)$$

where: UCL = 95 percent UCL on the mean

$\bar{X}$ = Arithmetic average

t = One-sided t distribution factor ($t_{0.95, n-1}$)

S = standard deviation

n = number of samples

For log-normally distributed data sets, the 95 percent UCL on the mean is calculated using the following equation:

$$UCL = \exp\left(\bar{X} + 0.5\,S^2 + \frac{HS}{(n-1)^{1/2}}\right)$$

where: UCL = 95 percent UCL on the mean

exp = Constant (base of the natural log, e)

$\bar{X}$ = Mean of the transformed data

S = Standard deviation of the transformed data

H = H-statistic (from Gilbert, 1987; $H_{0.95}$)

n = Number of samples

This equation uses individual sample results that have been transformed by taking the natural logarithm of the results.

Sample calculations for determining the distribution of a data set, 95 percent UCL on the mean, average, and maximum concentrations are provided in Appendix B-5. After the 95 percent UCL on the mean was calculated, it was compared to the maximum detected concentration within the data set. In data sets in which the calculated 95 percent UCL on the mean exceeded the maximum detected concentration, the maximum detected concentration was used as the exposure point concentration. This is a common problem in small datasets or datasets with high detection limits. Support documentation for the calculation of the 95 percent UCLs on the mean is presented in Appendix B-5. Exposure point concentrations used in the risk assessment are presented in Appendix B-1, Tables 3.1 through 3.24.

2.7.3 Exposure Assessment

The exposure assessment defines and evaluates the exposures that may be experienced by a receptor population. To have an exposure, several factors must be present: there must be a source of contamination, there must be a mechanism through which a receptor can come into contact with the contaminants in that medium, and there must actually (or potentially) be a receptor present at the point of contact.

The exposure assessment presented consists of several sections that characterize the physical site setting and the receptors of concern, identifies the potential contaminant migration and exposure pathways, and presents the equations used to quantify exposure in terms of contaminant intake (dose). Appendix B-6 of this report contains sample calculations for the exposure assessment. Exposure assumptions are presented in Appendix B-1, Tables 4.1 through 4.3. Intakes are presented in Appendix B-1, Tables 7.1 through 7.24 and 8.1 through 8.24.

2.7.3.1 Conceptual Site Model

This section discusses the general conceptual site model for the OU6 properties. A conceptual site model facilitates a consistent and comprehensive evaluation of the risks to human health by creating a framework for identifying the paths by which human health may be impacted by contaminants predicted to exist at the source areas. A conceptual site model depicts the relationships between the following elements necessary to construct a complete exposure pathway:

- Sources and potential COPCs;
- Contaminant release mechanisms and transport pathways;
- Exposure mechanisms and exposure routes; and
- Receptors.

One simple conceptual site model was developed for all the OU6 properties to provide the basis for identifying the potential risks to human health and the environment. The model considers the current and future conditions within the study area, and the actual or potential receptors that might come into contact with the COPCs.

The conceptual site model first considers the contaminant sources assumed to be available, either currently or in the future. For this model, the Raymark Facility waste disposed of within the Study Areas is considered the source. Contaminants may be released from this source by mechanisms such as wind, water erosion, leaching to the subsurface, or excavation within areas of contamination. Once released from the source, contaminants are transported in media such as air, surface water, or groundwater. Receptors may be exposed either directly or indirectly to contaminants in environmental media via a variety of mechanisms. The exposure mechanisms considered include recreation, working outdoors, etc. These exposure mechanisms generally act along one or more exposure routes such as ingestion, inhalation, or direct dermal contact.

The conceptual site model also indicates those exposure routes that are carried through the quantitative risk assessment for each receptor. An objective of developing the conceptual site model is to focus attention on those pathways that contribute the most to the potential impacts

on human health and the environment, and to provide the rationale for screening out other exposure pathways that are minor components of the overall risk.

Sources of Contamination. As discussed in Section 1.3, the Raymark Industries, Inc. (Raymark) Facility manufactured friction materials containing asbestos and non-asbestos materials, metals, phenol-formaldehyde resins, and various adhesives. As a result of these activities, soils at the former Raymark Facility were contaminated primarily with asbestos, lead, and PCBs. Raymark operated from 1919 until 1989, when the plant was shut down and permanently closed. While the Raymark Facility was active, it was common practice for the company to give away its excess manufacturing wastes for use as fill within the Town of Stratford. Each of the OU6 properties received some of this soil/waste/fill.

Contaminant Release and Migration Mechanisms. Chemicals may be released from the study area by a variety of mechanisms. These mechanisms include stormwater runoff and subsequent surface soil erosion, soluble chemicals infiltration and subsequent migration through the subsurface soil to the water table where the chemicals may migrate downgradient, wind erosion of surface soil from unpaved areas, disturbance of contaminants in soil through human excavation or animal burrowing activities, and through cracks in asphalt pavement, if present. Contaminant fate and transport are discussed in Section 2.6.

Exposure Setting. The potential for exposure at these 24 properties is based on several factors, including current and future land uses, human activity patterns, site access controls, and chemical behavior in the environment. Based on these variables, exposure scenarios were developed to characterize the potential for human exposure under current and future site conditions. This exposure evaluation scenario accounts for possible or anticipated changes in land use and site characteristics that may alter exposure and/or concentrations of COPCs in a given medium, in addition to the exposures that may result from current uses of the land.

The exposure assessment is based on the assumption that, in general, chemical compositions for environmental media are identical under current and future site conditions. Under current and future conditions, potential human receptors (residents, recreational visitors, and commercial workers) are assumed to be exposed to soils collected from depths of 0 to 15 feet bgs within estimated areas of Raymark waste. In the future, contaminated soils currently

located at depth and/or beneath pavement to a maximum depth of 15 feet bgs may be brought to the surface during land development (excavation/construction). Current exposures to soils located at depths of 15 feet bgs are unlikely, except in the case of excavation/construction activity. However, in the interest of efficiency in dealing with 24 separate properties and to be consistent with Connecticut's definition of accessible soils, this risk assessment considers one dataset of soils collected from 0 to 15 feet bgs for each property for combined current and future exposures.

A summary of the potentially significant exposures identified for quantitative evaluation is provided in Appendix B-1, Table 1. These exposures were identified based on property-specific information concerning land-use and potentially exposed populations.

Land Use. Individual OU6 properties are described in detail in Section 3. The OU6 properties include 20 commercial properties, two residential properties, and two recreational properties, as listed in Table 1-1. A description of each is included in Section 3. Current use, zoning, and the Strategic Redevelopment Initiative (SRI) report (Maguire, 2003) were considered in the determination of current and reasonably anticipated future uses. Future on-site residents were not included in the HHRA for the 20 OU6 commercial properties. Current land use and zoning at each of the commercial properties suggests that the area is valuable as commercial property and will remain commercial. If the property-use changes, risks would need to be re-evaluated. Based on the SRI report (Maguire, 2003), one commercially-zoned property has a potential future use as a hotel/marina complex. For this reason, both recreational use and commercial use were considered at the Lockwood Avenue Property. Other future uses discussed in the SRI report are consistent with the commercial scenarios evaluated in this RI. One other commercial property (the CT Right-of-Way) includes an easement allowing access to a residential property. In addition to the whole property's consideration for commercial use, the easement area is considered for residential use.

Evidence indicates that each of these properties received wastes from the former Raymark Industries Inc.

Exposed Populations. The OU6 properties are located in Stratford, Fairfield County, Connecticut. The principal industries within the community of Stratford include manufacturing

aircraft, air conditioners, chemicals, plastic, paper, rubber goods, electrical and machine parts, and toys. There were 49,389 people reported to live in the Town in 2003. Potentially exposed populations at each OU6 property are discussed in Section 3.

Receptors. Several potential receptor populations were initially considered for inclusion in the exposure assessment. However, the majority of these receptors were eliminated from further evaluation based on the current land use, site access, COPCs, and the likelihood of exposure. Of the receptors initially considered (residents, recreational visitors, commercial workers, construction workers, and trespassers), the receptors retained for quantitative evaluation are commercial workers, residents, and recreational visitors.

Possible exposures of commercial workers to site-related contaminants would be through commercial/industrial activities within the estimated areas of Raymark waste at individual commercial OU6 properties. For purposes of evaluation of the commercial worker exposures, the commercial worker scenario was defined as an outdoor worker in direct contact with soils 250 days per year. This scenario is protective of commercial workers who may be present less frequently or those who may work primarily indoors. The scenario is also protective of customers, shoppers, and adolescent trespassers who may visit the property frequently. This scenario is not necessarily protective of future residential or recreational land use.

Possible exposures of residents to site-related contaminants would be through play or yard-work activities within the estimated areas of Raymark waste at individual residential OU6 properties.

Possible exposures of recreational visitors to site-related contaminants would be through recreational activities within the estimated areas of Raymark waste at individual recreational OU6 properties. Conservative exposure assumptions were selected for the evaluation of recreational exposures, since nearby residents may visit these properties frequently. The conservative exposure assumptions that were selected for the evaluation of recreational exposures are protective of trespassers.

Construction workers were not included in the HHRA for the OU6 properties. The HHRA was conducted assuming that the commercial worker, resident, or recreational visitor may be in

direct contact with soils as deep as 15 feet bgs on a frequent and long-term basis. Since these long-term scenarios are considered protective of a short-term construction worker scenario, the construction worker scenario was not evaluated separately.

2.7.3.2 Potential Routes of Exposure

A receptor can come into contact with contaminants in a variety of ways, which are generally the result of interactions between a receptor's behavior or lifestyle and an exposure medium. This HHRA defines an exposure route as a stylized description of the behavior that brings a receptor into contact with a contaminated medium. The exposure routes considered in this HHRA are discussed below.

Direct Contact with Soil

Receptors may come into direct contact with soil affected by the release of chemicals from the source areas. During the receptor's period of contact, the individual may be exposed via inadvertent ingestion of a small amount of soil or via dermal absorption of certain contaminants from the soil.

Because of the limited guidance available to estimate soil exposure via dermal contact, dermal risks can only be evaluated quantitatively for contaminants with available soil absorption factors. Several of these chemicals were selected as COPCs for the OU6 properties. Therefore, dermal risks associated with soil were quantitatively addressed in the risk assessment. Dermal contact with other chemicals detected in the site soils may or may not result in a significant exposure. It should be noted that organics such as PAHs, which were detected frequently in the soil samples and selected as COPCs, tend to strongly adhere to organic matter in soil. For these chemicals to be percutaneously absorbed, they must first desorb from soil and diffuse through the skin. Various factors affect the rate of dermal absorption, including the amount of soil on the skin surface, soil characteristics (moisture, pH, organic carbon content, etc.), skin characteristics (thickness, temperature, hydration, etc.), volatilization losses, and chemical-specific properties.

Air

Contact with this medium is based on the scenario that a receptor is immersed in air that contains suspended particulates and volatile organic vapors originating from the source areas as part of daily living. Subsequent exposure of the receptor occurs upon inhalation of the ambient air.

A qualitative comparison of maximum detected soil concentrations and EPA Generic Soil Screening Levels (SSLs) for inhalation, based on intermedia transfer from soil to air (EPA, 1996a), was performed to determine if additional quantitative analysis of this potential exposure pathway was warranted. Generic SSLs for inhalation are modeled soil concentrations based on a back calculation of dust concentrations associated with a one-in-a-million (10^{-6}) cancer risk for carcinogens or a hazard quotient (HQ) of one for non-carcinogens. These concentrations are derived from equations combining default exposure information assumptions chosen to be protective of human health for most site conditions with EPA toxicity data. Generally, at sites where contaminant concentrations fall below SSLs, no further action or study is warranted under CERCLA. The inhalation SSLs are based on residential land use and lifetime exposure scenarios and are therefore relatively conservative values for potential receptors at the commercial properties. Appendix B-1 and Tables 2.1 through 2.24 present the inhalation SSLs for residential land-use. For commercial properties with exceedances of residential inhalation SSLs, further evaluation was performed comparing property-specific data to industrial/ commercial inhalation SSLs (EPA, 2001a).

Qualitative evaluations of potential inhalation risks from exposures to asbestos were performed for each property. The presence of pavement and/or vegetative cover at each property reduces the potential for airborne asbestos. Based on field conditions at the OU6 properties, it is likely that asbestos does not currently present a significant inhalation risk from the estimated areas of Raymark waste at the OU6 properties. Disturbances of asbestos-containing soil through excavation will increase the potential for airborne asbestos exposures and associated inhalation risks.

Exposures to fugitive dust and VOCs released from soil were found to be insignificant in most cases based on the qualitative screening and asbestos evaluations. Results of this qualitative comparison and the asbestos evaluations are discussed for individual properties in Section 3.

2.7.3.3 Potential Receptors

Several potential receptors have been identified under current and future land use conditions. These receptors were identified by analyzing the interaction of current and anticipated future land use practices with the identified sources of contamination. Three receptor groups have been defined for this risk assessment. These receptors are as follows:

- Commercial Workers - Adults working 40 hours per week at a commercial facility within the OU6 Study Area. This scenario is protective of current and future commercial workers who may be present less frequently or those who may work primarily indoors, as well as trespassers, customers, and shoppers who may frequent the property. This long-term scenario is also considered to be protective of a short-term construction worker scenario.

- Residents - Residents (adults and children) who reside at properties located in the OU6 Study Area. This scenario is protective of recreational visitors and trespassers, as well as current or future residents and adolescent trespassers.

- Recreational Visitors - Recreational visitors (adults and children) may visit an OU6 property on a frequent basis for play or leisure activities. The conservative exposure assumptions that were selected for the evaluation of recreational exposures are also protective of trespassers.

Table 1 of Appendix B-1 presents the receptors and exposure pathways identified for the individual OU6 properties, and provides the rationale for the quantitative evaluation of the selected exposure pathways.

The receptors were evaluated using the reasonable maximum exposure (RME) scenarios, developed according to EPA guidance (EPA, 1989b and 1994c). The RME is conceptually the "high end" exposure, above the 90^{TH} percentile of the population distribution, but not higher than the individual in the population with the highest exposure. Therefore, the RME scenario represents a "reasonable worst case" exposure scenario.

Commercial Workers

The adult commercial worker was evaluated for exposures to soils at the estimated areas of Raymark waste to a depth of 15 feet bgs, regardless of pavement, for the current and/or future land use scenario. In the future, contaminated soils currently located at depth and/or beneath pavement may be brought to the surface through excavation and land development.

Possible exposures of commercial workers to site-related contaminants would be through inadvertent contact. Commercial workers are assumed to be exposed to site media 250 days/year and to ingest an average of 100 mg/day for 25 years. The fraction of soil intake derived from the contaminated source is set at the fraction of a property that is estimated to contain Raymark waste (FRW). The same contact rates were used for paved and unpaved Raymark waste areas; although paved areas will reduce worker exposure. Table 1-1 presents the FRW values for all OU6 properties. The use of the FRW value serves to prorate exposures, assuming that receptors spend time within the estimated areas of Raymark waste at a property in direct proportion to the fraction of the total property within the estimated areas of Raymark waste. Exposures and associated risks from contaminants outside the estimated areas of Raymark waste at a property are not evaluated in this risk assessment. Hands, forearms, lower legs, and head are expected to be available for dermal contact with soil. The calculated available skin surface area for dermal contact with soil for adults was 3,300 cm^2. A value of 0.2 mg/cm^2 was used as the soil-to-skin adherence factor for adult commercial workers. This value corresponds to 50^{th} percentile weighted adherence values for heavy equipment operators and utility workers. These are considered high-end soil contact activities (EPA, 2001b).

Residents

Adult and child residents were evaluated for exposures to the soils at the estimated areas of Raymark waste at three properties. The Third Avenue Property is a residential property. While the Vacant Lot at Housatonic Avenue property is currently vacant and is land-locked, it is zoned for residential land-use, therefore it was evaluated for residential use. The CT Right-of-Way property includes an easement allowing access to a residential property; therefore, this easement portion of this property was evaluated for residential use. Residents of these

properties were assumed to be adults and young children. Adult and child residents were evaluated for exposures to soils at the estimated areas of Raymark waste to a depth of 15 feet bgs, regardless of pavement. CT DEP defines accessible soils as those found at depths of 15 feet bgs or less.

Site-specific considerations were used to determine exposure frequencies for residents. Residents were assumed to be exposed 350 days/year. This exposure frequency is the CT DEP and EPA default exposure frequency for residents (EPA, 1991a). Adult receptors are assumed to ingest an average of 100 mg/day for 24 years. Child receptors are assumed to ingest an average of 200 mg/day for 6 years. The fraction of soil intake derived from the contaminated source is set at the fraction of a property that is estimated to contain Raymark waste (FRW). Table 1-1 presents the FRW values for all OU6 properties. The use of the FRW value serves to prorate exposures, assuming that receptors spend time within the estimated areas of Raymark waste at a property in direct proportion to the fraction of the total property within the estimated areas of Raymark waste. Exposures and associated risks from contaminants outside the estimated areas of Raymark waste at a property were not evaluated in this risk assessment. The proposed exposure duration values are based on EPA guidance for RME evaluation (EPA, 1997b). Values for small children for the RME reflect the entire age span for children 0 to 6 years of age.

Hands, forearms, lower legs, feet, and head are expected to be available for dermal contact with soil for young children. Hands, forearms, lower legs, and head are expected to be available for dermal contact with soil for adults. The calculated available skin surface areas for dermal contact with soil for adults and small children (ages 0-6 years) were 5,700 cm^2 and 2,800 cm^2, respectively. Values of 0.07 mg/cm^2 were used as soil-to-skin adherence factors for adult exposures. The adult resident's soil-to-skin adherence factor corresponds to 50^{th} percentile weighted adherence values for gardeners. Gardening is considered a high-end soil contact activity. Values of 0.2 mg/cm^2 were used as soil-to-skin adherence factors for child exposures. These values represent 50^{th} percentile values estimated for children playing in wet soil. This activity is considered a high-end soil contact activity. The values have been recommended in EPA's "Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment)" (EPA,

2001b). The values were based on data presented in the 1997 version of the EPA Exposure Factor Handbook.

Recreational Visitors

Adult and child recreational visitors were evaluated for current and future exposures to the soils at the estimated areas of Raymark waste at two properties, Wooster Park and the Beacon Point Area and for potential future exposures to the soils at the estimated areas of Raymark waste at the Lockwood Avenue Property. Recreational visitors to these properties were assumed to be adults and young children. Adult and child recreational visitors were evaluated for exposures to soils at the estimated areas of Raymark waste to a depth of 15 feet bgs, regardless of pavement. CT DEP defines accessible soils as those found at depths of 15 feet bgs or less. These samples were included to address concerns for future exposures when excavation or construction may bring these soils to the surface.

Site-specific considerations were used to determine exposure frequencies for recreational visitors. This receptor was assumed to have a high frequency of exposure such that exposure assumptions for recreational visitors were 150 days/year, due to the presence of residential properties bordering these properties. All other exposure assumptions match those of residents, described above. Adult receptors are assumed to ingest an average of 100 mg/day for 24 years. Child receptors are assumed to ingest an average of 200 mg/day for 6 years. The fraction of soil intake derived from the contaminated source is set at the fraction of a property that is estimated to contain Raymark waste (FRW). Table 1-1 presents the FRW values for all OU6 properties. The use of the FRW value serves to prorate exposures, assuming that receptors spend time in the estimated areas of Raymark waste at a property in direct proportion to the fraction of the property within the estimated areas of Raymark waste. Exposures and associated risks from contaminants outside the estimated areas of Raymark waste are not evaluated in this risk assessment. The proposed exposure duration values are based on EPA guidance for RME evaluation (EPA, 1997b). Values for small children for the RME reflect the entire age span for children 0 to 6 years of age.

Hands, forearms, lower legs, feet, and head are expected to be available for dermal contact with soil for young children. Hands, forearms, lower legs, and head are expected to be

available for dermal contact with soil for adults. The calculated available skin surface areas for dermal contact with soil for adults and small children (ages 0-6 years) were 5,700 cm^2 and 2,800 cm^2, respectively. Values of 0.07 mg/ cm^2 were used as soil-to-skin adherence factors for adult exposures. The adult resident's soil-to-skin adherence factor corresponds to 50^{th} percentile weighted adherence values for gardeners. Gardening is considered a high-end soil contact activity. Values of 0.2 mg/ cm^2 were used as soil-to-skin adherence factors for child exposures. These values represent 50^{th} percentile values estimated for children playing in wet soil. Children playing in wet soil is considered a central tendency soil contact activity. The values have been recommended in EPA's "Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment)" (EPA, 2001b). The values were based on data presented in the 1997 version of the EPA Exposure Factor Handbook.

2.7.3.4 Exposure Pathways

An exposure pathway consists of four elements: a source and mechanism of release; a route of contaminant transport through an environmental medium; a contact point for a human receptor; and an exposure route at the point of contact. All four components must be present for the exposure pathway to be considered complete. This section summarizes the potentially complete exposure pathways that were quantitatively evaluated in the risk assessment and provides the rationale for those pathways that were not evaluated. Appendix B-1, Table 1 presents a summary of the potentially complete and incomplete exposure pathways and receptors.

The primary routes of exposure for potential human receptors at the OU6 properties are incidental ingestion of and dermal contact with soil. Other potential exposure routes such as those associated with using groundwater or inhaling fugitive dust and volatile emissions, were not considered quantitatively for the following reasons:

- The shallow aquifer at the OU6 Study Area is not used as a potable water supply at any of the OU6 properties or in the surrounding areas. Shallow groundwater at the study area discharges to Ferry Creek and its tributaries. Thus, domestic groundwater exposures by nearby residents are eliminated. In addition, groundwater at the OU6

properties is not used or expected to be used in the future as a potable water supply because of brackish conditions in most areas and productivity constraints. Groundwater quality in Stratford is being investigated as a separate operable unit.

- Potential exposure to volatile emissions and fugitive dust from soils at the OU6 properties is considered to be minimal, based on the qualitative comparison of OU6 data to the EPA Generic SSLs for transfers from soil to air and field conditions at OU6 properties; thereby eliminating the need for quantitative evaluation of this exposure pathway. Qualitative evaluations of the inhalation pathway are provided.

Quantification of Exposure

Estimates of exposure are based on the contaminant concentrations at the exposure points and on scenario-specific assumptions and intake parameters. The models and equations used to quantify intakes are described in this section and have been obtained from a variety of EPA guidance documents that are cited in the specific intake estimation sections that follow.

Exposures depend on the predicted concentrations of chemicals in environmental media and local land use practices, and both are subject to change over time. This results in a large number of possible combinations of receptors, media, exposure pathways, and concentrations. As mentioned previously, Appendix B-1, Table 1 presents a summary of the exposure pathways evaluated in the quantitative risk assessment. These scenarios (commercial, residential, and recreational scenarios) are applicable under both current and future land use conditions.

Exposure model parameters are presented in Appendix B-1, Tables 4.1, 4.2A, 4.2B, 4.3A, and 4.3B. Table 4.1 presents exposure parameters for commercial properties. Tables 4.2A and 4.2B present exposure parameters for residential properties for adults and children. Tables 4.3A and 4.3B present exposure parameters for recreational properties for adults and children. The values reflect current EPA guidance and comments received from EPA Region I. All parameters are referenced in footnotes on each table. These parameters are used in the equations presented in this section, along with the exposure point concentrations presented in Appendix B-1, Tables 3.1 through 3.24, to calculate intakes, which are used to determine risks.

Individual chemical intakes for each receptor/exposure route combination are presented in Appendix B-1, Tables 7.1 through 7.24 and 8.1 through 8.24. Equations used to quantify intakes are presented below.

Incidental Ingestion of Soil. The estimation of intake of contaminants in soils is determined using the predicted concentration of a contaminant in the OU6 property of interest. This pathway is evaluated for adult commercial workers and both child and adult residents and recreational visitors. In general, intakes associated with soil ingestion are calculated using the following equation:

$$Intake = \frac{(C)(IR)(FRW)(OABS)(EF)(ED)(CF)}{(BW)(AT)}$$

where:

Intake	=	intake of contaminant from soil (mg/kg/day)
C	=	exposure concentration for soil (mg/kg)
IR	=	ingestion rate (mg/day)
FRW	=	fraction ingested from Raymark waste area (decimal fraction)
OABS	=	oral relative absorption factor (decimal fraction)
EF	=	exposure frequency (days/yr)
ED	=	exposure duration (yr)
CF	=	conversion factor (10^{-6} kg/mg)
BW	=	body weight (kg)
AT	=	averaging time (days); for non-carcinogens, AT=ED*365 days/yr; for carcinogens, AT=70 yr*365 days/yr

Appendix B-1, Tables 4.1, 4.2A, 4.2B, 4.3A, and 4.3B contain summaries of the input parameters for incidental ingestion of soil. Table 1-1 presents FRW values for all OU6 properties.

Dermal Contact with Soil

Dermal contact exposures to soil were evaluated for adult commercial workers and both child and adult residents and recreational users.

The following equation was used to estimate the dermal exposure dose for soil:

$$Dose\ \ (mg/kg/day) = \frac{(C)(FRW)(DABS)(AF)(SA)(EF)(ED)(CF)}{(BW)(AT)}$$

where:

C	=	exposure concentration for soil (mg/kg)
FRW	=	fraction from Raymark waste area (decimal fraction)
DABS	=	dermal absorption factor (unitless)
AF	=	soil-to-skin adherence factor (mg/cm^2)
SA	=	skin area available for contact (cm^2/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
CF	=	conversion factor ($1E^{-6}$ kg/mg)
BW	=	body weight (kg)
AT	=	averaging time (70 years * 365 days/year for carcinogens; ED * 365 days/year for non-carcinogens)

Chemical-specific dermal absorption factors (DABS), presented in EPA's "Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, (Part E, Supplemental Guidance for Dermal Risk Assessment)" (EPA, 2001b), were used to estimate exposure doses. Unfortunately, limited information regarding dermal absorption is available. The DABS values, where available, for the COPCs are presented in Appendix B-1, Table 5.1. Because of the absence of dermal absorption data, TtNUS qualitatively evaluated dermal exposures to all other COPCs.

Input parameters for dermal contact with soil are summarized in Appendix B-1, Tables 4.1, 4.2A, 4.2B, 4.3A, and 4.3B. Table 1-1 presents FRW values for all OU6 properties.

2.7.4 Toxicity Assessment

The toxicity assessment for the COPCs examines information concerning the potential human health effects of exposure to COPCs. The goal of the toxicity assessment is to provide, for each COPC, a quantitative estimate of the relationship between the magnitude and type of exposure and the severity or probability of human health effects. The toxicity values presented in this section are integrated with the exposure assessment (Section 2.7.3) to characterize the potential for the occurrence of adverse health effects (Section 2.7.5).

The toxicological evaluation involves a critical review and interpretation of toxicity data from epidemiological, clinical, animal, and in vitro studies. This review of the data ideally determines both the nature of the health effects associated with a particular chemical and the probability that a given quantity of a chemical could result in the referenced effect. This analysis defines the relationship between the dose received and the incidence of an adverse effect for the chemicals of potential concern.

The entire toxicological database is used to guide the derivation of cancer slope factors (CSFs) for carcinogenic effects and Reference Doses (RfDs) for non-carcinogenic effects. These data may include epidemiological studies, long-term animal bioassays, short-term tests, and evaluations of molecular structure. Data from these sources are reviewed to determine if a chemical is likely to be toxic to humans. Because of the lack of available human studies, however, the majority of toxicity data used to derive CSFs and RfDs comes from animal studies.

For non-carcinogenic effects, the most appropriate animal model (the species most biologically similar to the human) is identified. Pharmacokinetic data often enter into this determination. In the absence of sufficient data to identify the most appropriate animal model, the most sensitive species is chosen. The RfD is generally derived from the most comprehensive toxicology study that characterizes the dose-response relationship for the critical effect of the chemical. Preference is given to studies using the exposure route of concern; in the absence of such

data, however, an RfD for one route of exposure may be extrapolated from data from a study that evaluated a different route of exposure. Such extrapolation must take into account pharmacokinetic and toxicological differences between the routes of exposure. Uncertainty factors are applied to the highest no-observed-adverse-effect-level (NOAEL) to adjust for inter- and intraspecies variation, deficiencies in the toxicological database, and use of subchronic rather than chronic animal studies. Additional uncertainty factors may be applied to estimate a NOAEL from a lowest-observed-adverse-effect-level (LOAEL) if the key study failed to determine a NOAEL. When chemical-specific data are not sufficient, an RfD may be derived from data for a chemical with structural and toxicological similarity.

CSFs for weight-of-evidence Group A or B chemicals are generally derived from positive cancer studies that adequately identify the target organ in the test animal data and characterize the dose-response relationship. CSFs are derived for Group C compounds for which the data are sufficient, but are not derived for Group D or E chemicals. (An explanation/definition of these weight-of-evidence classes is provided in Section 2.7.4.2). Preference is given to studies using the route of exposure of concern, in which normal physiologic function was not impaired, and in which exposure occurred during most of the animal's lifetime. Exposure and pharmacokinetic considerations are used to estimate equivalent human doses for computation of the CSF. When a number of studies of similar quality are available, the data may be combined in the derivation of the CSF.

Brief summaries of the toxicity profiles for the major COPCs are presented in Appendix B-7. These profiles present a summary of the available literature on carcinogenic and non-carcinogenic effects associated with human exposure to the chemical. For more in depth information see www.epa.gov/iris/indes.html or www.atsdr.cdc.gov/toxpro2.html.

2.7.4.1 Non-carcinogenic Effects

For non-carcinogens, it is assumed that there exists a dose below which no adverse health effects will be seen. Below this "threshold" dose, exposure to a chemical can be tolerated without adverse effects. Therefore, for non-carcinogens, a range of exposure exists that can be tolerated. Toxic effects are manifested only when physiologic protective mechanisms are

overcome by exposures to a chemical above its threshold level. Maternal and developmental endpoints are considered systemic toxicity.

The potential for non-carcinogenic health effects resulting from exposure to chemicals is assessed by comparing an exposure estimate (intake or dose) to an RfD. The RfD is expressed in units of mg/kg/day and represents a daily intake of contaminant per kilogram of body weight that is not sufficient to cause the threshold effect of concern. An RfD is specific to the chemical, the route of exposure, and the duration over which the exposure occurs.

To derive an RfD, EPA reviews all relevant human and animal studies for each compound and selects the study (studies) pertinent to the derivation of the specific RfD. Each study is evaluated to determine the NOAEL or, if the data are inadequate for such a determination, the LOAEL. The NOAEL corresponds to the dose (in mg/kg/day) that can be administered over a lifetime without inducing observable adverse effects. The LOAEL corresponds to the lowest daily dose that induces an observable adverse effect. The toxic effect characterized by the LOAEL is referred to as the "critical effect." To derive an RfD, the NOAEL (or LOAEL) is divided by uncertainty factors to ensure that the RfD will be protective of human health. Uncertainty factors are applied to account for extrapolation of data from laboratory animals to humans (interspecies extrapolation), variation in human sensitivity to the toxic effects of a compound (intraspecies differences), derivation of a chronic RfD based on a subchronic rather than a chronic study, or derivation of an RfD from the LOAEL rather than the NOAEL. In addition to these uncertainty factors, modifying factors between 1 and 10 may be applied to reflect additional qualitative considerations in evaluating the data. For most compounds, the modifying factor is one.

A dermal RfD is developed by multiplying an oral RfD (based on an administered dose) by the gastrointestinal tract absorption factor. The resulting dermal RfD, based on an absorbed dose, is used to evaluate the dermal (absorbed) dose calculated by the dermal exposure algorithms.

EPA's database (IRIS - the Integrated Risk Information System) (EPA, 2003) was consulted as the primary source for RfD values, as well as for CSFs. EPA intends that IRIS supersede all other sources of toxicity information for risk assessment. If values are not available in IRIS, the Health Effects Assessment Summary Tables (HEAST) (EPA, 1997a) are consulted, as well

as the current Region IX EPA Preliminary Remediation Goals (PRGs) Table (EPA, 2002). If no RfD is available from any of these sources, non-carcinogenic risks are not quantified and potential exposures are addressed in the uncertainty section, Section 2.7.6.

Reference Doses for the COPCs at the OU6 properties are presented in Appendix B-1, Table 5.1. This table also includes the primary target organs affected by a particular chemical. This information may be used in the property-specific risk characterization sections to segregate risks by target organ effects when the total Hazard Index is greater than unity.

PCB risk characterization is generally addressed by evaluating total Aroclor concentrations. The PCB non-cancer risk estimates presented in this assessment were based on total Aroclor concentrations. Total Aroclor concentrations were determined on a sample-specific basis by summing individual Aroclor concentrations; one-half the detection limit was used as a surrogate for non-detect results. In situations in which only one or two Aroclors were detected, the total Aroclor value may be strongly influenced by the detection limit values of non-detected Aroclors. For non-carcinogenic risk, only two PCB commercial Aroclor formulations, Aroclor 1016 and Aroclor 1254, have oral RfDs available. The oral RfD for Aroclor 1016 is 7.00E-05 mg/kg/day and the oral RfD for Aroclor 1254 is 2.00E-05 mg/kg/day. PCB non-cancer risk can be evaluated using the total Aroclor concentration and the RfD for the more toxic Aroclor (Aroclor 1254). This approach is conservative and tends to overestimate risks due to the lighter Aroclors. Within the estimated areas of Raymark waste at the OU6 properties, the heavier Aroclors, Aroclor 1262 and Aroclor 1268, generally comprise the majority of the total Aroclor concentration. Due to the high proportion of heavy Aroclors, the use of total Aroclors, in combination with the RfD for Aroclor 1254, for evaluating non-cancer risks, is not likely to significantly overestimate risks.

2.7.4.2 Carcinogenic Effects

The toxicity information considered in the assessment of potential carcinogenic risks includes a slope factor and a weight-of-evidence classification consistent with EPA's 1986 *Guidelines for* Carcinogenic Risk *Assessment* (EPA, 1986). A revised weight-of-evidence classification system has been developed and presented in the *Draft Revised Guidelines for Carcinogenic Risk Assessment* (EPA, 1999a); however, none of the COPCs for OU6 are impacted at this

time. The 1986 weight-of-evidence classification qualitatively describes the likelihood that a chemical is a human carcinogen and is based on an evaluation of the available data from human and animal studies. A chemical may be placed in one of the following five groups in EPA's 1986 classification system to denote its potential for carcinogenic effects:

- Group A - known human carcinogen
- Group B1 or B2 - probable human carcinogen
- Group C - possible human carcinogen
- Group D – cannot be classified as a human carcinogen because of a lack of data
- Group E - evidence of noncarcinogenicity in humans

The CSF is the toxicity value used to quantitatively express the carcinogenic hazard of cancer-causing chemicals. It is defined in the IRIS glossary as: “An upper-bound, approximately a 95 percent confidence limit, on the increased cancer risk from a lifetime exposure to an agent. This estimate, usually expressed in units of proportion (of a population) affected per mg/kg/day, is generally reserved for use in the low-dose region of the dose-response relationship, that is, for exposures corresponding to risks less than 1 in 100.” (EPA, 2003). Slope factors are derived from studies of carcinogenicity in humans and/or laboratory animals and are typically calculated for compounds in Groups A, B1, and B2, although some Group C carcinogens also have slope factors and some B2 carcinogens, such as lead, have none. Slope factors are specific to a chemical and route of exposure and are expressed in units of $(mg/kg/day)^{-1}$ for oral routes. CSFs for COPCs at the OU6 properties are presented in Appendix B-1, Table 6.1. The primary source of information for these values is the EPA IRIS database, followed by other EPA sources described for non-carcinogens.

CSFs exist for several (but not all) Group C compounds, which are identified as "possible" human carcinogens. These compounds typically exhibit inadequate evidence of carcinogenicity in humans and limited evidence in animals. No Group C compounds were identified as COPCs.

Dermal CSFs are derived from the corresponding oral values. To derive the dermal CSF, the oral CSF is divided by the gastrointestinal absorption efficiency to determine a CSF based on an absorbed dose rather than an administered dose. The oral CSF is divided by the

absorption efficiency because CSFs are expressed as reciprocal doses. Dermal CSFs and the absorption efficiencies used in their determination are also included in Appendix B-1, Table 6.1. The absorption efficiencies were obtained from Table 4.1, "Summary of Gastrointestinal Absorption Efficiencies and Recommendations for Adjustment of Oral Slope Factors for Specific Compounds" of the EPA's "Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment" (EPA, 2001b).

Risk estimates for PAHs have, in the past, assumed that all carcinogenic PAHs have a potency equal to that for benzo(a)pyrene. While benzo(a)pyrene was well studied, other Class B2 PAHs had insufficient data with which to calculate a CSF. EPA has published provisional guidance to assess PAHs (EPA, 1993). Estimated orders of potential potency (rather than a toxicity equivalence factor or TEF) were developed based on skin painting tests and are rounded to one significant figure (based on an order of magnitude). The values are based on a comparable endpoint (complete carcinogenesis after repeated exposure to mouse skin). The quality of the data does not support any greater precision. The orders of potential potency used in this HHRA are presented in Appendix B-8 and are those proposed for use by EPA Region I (EPA, 1994c). EPA has determined that the oral CSF for benzo(a)pyrene is 7.3 $(mg/kg/day)^{-1}$. Oral CSFs for other carcinogenic PAHs were determined by multiplying the oral CSF for benzo(a)pyrene by the estimated order of potential potency for the PAH. These oral CSFs for PAHs became the basis for deriving the dermal CSFs used to evaluate dermal risk from PAHs.

The toxicity and cancer risk characterization of PCBs was conducted according to guidance presented in the EPA technical guidance document entitled, "PCBs: Cancer Dose-Response Assessment and Application to Environmental Mixtures" (EPA, 1996b). The guidance document suggests a methodology for the risk evaluation of the total Aroclor concentration in an environmental medium.

Risk estimates for dioxins were evaluated through the use of dioxin TEQs as described in Section 2.7.2.1. Dioxin TEQs were used in conjunction with the toxicity value for 2,3,7,8-TCDD of 1.5 E+5 $(mg/kg/day)^{-1}$ from IRIS (EPA, 2003) in determining cancer risk. Use of this cancer slope factor for dioxins may underestimate risks from exposure to dioxins. This CSF is being

reviewed by EPA. EPA has prepared a Draft Dioxin Reassessment (EPA, 2000), which recommends a CSF for dioxins of 1.0E+6 $(mg/kg/day)^{-1}$. Appendix B-9 presents the cancer risks from exposures to dioxins using the CSF of 1.0E+6$(mg/kg/day)^{-1}$. Cancer risks estimated using this approach are approximately an order of magnitude greater than risks calculated using the CSF of 1.5E + 5 $(mg/kg/day)^{-1}$.

2.7.5 Risk Characterization Methodology

This section outlines the methods used to estimate the type and magnitude of potential human health risks associated with the potential exposure to COPCs in soils at estimated areas of Raymark waste at the OU6 properties. The risk results for the individual OU6 properties are presented in Section 3.

Potential human health risks resulting from exposure to COPCs were estimated using algorithms established by EPA. The methods described by EPA are protective of human health and are likely to overestimate (rather than underestimate) risk. The methodology uses specific algorithms to calculate risk as a function of chemical concentration, human exposure parameters, and toxicity.

Risks from hazardous chemicals are calculated for either carcinogenic or non-carcinogenic effects. Some carcinogenic chemicals may also exhibit non-carcinogenic effects. Potential impacts are then characterized for both types of health effects.

2.7.5.1 Non-Carcinogens

The hazards associated with the effects of non-carcinogenic chemicals are evaluated by comparing an exposure level or intake to an RfD. The ratio of the intake to the RfD is called the Hazard Quotient (HQ) and is defined as follows (EPA, 1989b):

$$HQ_i = \frac{Intake_i}{RfD_i}$$

where: HQ_i = Hazard Quotient for chemical "i" (unitless)

$Intake_i$ = Intake of chemical "i" (mg/kg/day), a function of exposure and chemical concentration

RfD_i = Reference Dose of chemical "i" (mg/kg/day)

If the ratio of the intake to the RfD exceeds unity, there exists a potential for non-carcinogenic (toxic) effects to occur. A Hazard Index (HI) is generated by summing the individual HQs for all COPCs. If the value of the HI exceeds unity, there is a potential for non-carcinogenic health effects associated with that particular chemical mixture, and therefore it is necessary to segregate the HQs by target organ effects. The HQ should not be construed as a probability, but rather as a numerical indicator of the extent to which a predicted intake exceeds or is less than an RfD.

2.7.5.2 Chemical Carcinogens

Risks attributable to exposure to chemical carcinogens are estimated as the probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen. At low doses, the incremental lifetime cancer risk (ILCR) is determined as follows (EPA, 1989b):

$$ILCR_i = (Intake_i)(CSF_i)$$

where: $ILCR_i$ = Incremental Lifetime Cancer Risk for chemical "i", expressed as a unitless probability

$Intake_i$ = Intake of chemical "i" (mg/kg/day)

CSF_i = Cancer Slope Factor of chemical "i" $(mg/kg/day)^{-1}$

Risks below 1E-6 (or a risk less than 1 in 1 million) are generally considered to be acceptable by EPA, and risks greater than 1E-4 (1 in 10,000) are generally considered to be unacceptable. The CT DEP regulations use 1E-5 (1 in 100,000) as a break point between acceptable and unacceptable risk for cumulative cancer risk from multiple contaminants and a break point of 1E-6 (one-in-a-million) cancer risk for individual contaminants (CT DEP, 1996).

Risks are estimated for all carcinogenic compounds regardless of the class designation (See Section 2.7.4.2).

2.7.5.3 Exposure to Lead

Risks from lead exposure are not evaluated using the same methodology as other contaminants. Residential and recreational child exposure to lead was evaluated using the EPA Integrated Exposure Uptake Biokinetic (IEUBK) Model for lead (EPA, 1994a). This model is designed to estimate blood levels of lead in children (under 7 years of age) based on either default or site-specific input values for air, drinking water, diet, dust, and soil exposure. Since children are a more sensitive subpopulation than adults, exposure to lead by adults in a residential scenario is not generally evaluated. Exposures to lead by non-residential adults (commercial workers) are evaluated by use of a slope-factor approach developed by the EPA Technical Review Workgroup for Lead (EPA, 1996c and 1996d). The slope factor approach focuses on estimating fetal blood-lead concentrations in women exposed to lead-contaminated soil in non-residential scenarios.

Blood-lead concentration is the most widely used index of internal lead body burdens associated with potential adverse health effects. Studies indicate that infants and young children are extremely susceptible to adverse effects from exposure to lead. Considerable behavioral and developmental impairments have been noted in children with elevated blood-lead levels. The threshold for toxic effects to children from this chemical is believed to be in the range of 10 micrograms/deciliter (µg/dL) to 15 µg/dL. Blood-lead levels greater than 10 µg/dL are considered to be a "concern."

Either the IEUBK Model or the Technical Review Work Group Model for lead was used to address exposures to lead at each OU6 property. Exposure concentrations, as well as default parameters for some input parameters, were used in the evaluation. Because the output of these models is a range of predicted blood-lead concentrations, it is appropriate to input average soil lead concentrations rather than 95 percent UCL on the mean values. Entering a 95 percent UCL on the mean tends to bias the model outputs toward the high end, thus potentially overestimating risk. The exposure point concentrations selected for use in this evaluation are the arithmetic average soil lead concentrations for the exposure areas. In order

to prorate exposures, the fraction of the property estimated to contain Raymark waste (FRW) is factored into the models. This approach assumes the receptor spends time within the estimated areas of Raymark waste in direct proportion to the fraction of the total property estimated to contain Raymark waste. Exposures outside the estimated areas of Raymark waste are not evaluated. For the IEUBK model, the average lead concentration is multiplied by the FRW to yield a time-weighted average concentration, which is then used as the exposure point concentration. For the EPA Technical Review Workgroup Model, the FRW is included in the intake equations shown in Appendix B-10.

Exposure to lead in soils by adults at the OU6 commercial properties was evaluated using the EPA Technical Review Workgroup for Lead (EPA, December 1996b). The model estimates the 95th percentile blood-lead concentration among fetuses born to women having site exposures. These concentrations are then compared to the established level of concern of 10 μg/dL. An additional step in the process estimates the probability that fetal blood-lead levels will exceed 10 μg/dL. EPA's stated goal for lead is that individuals exposed would have no more than a 5 percent probability of exceeding the level of concern of 10 μg/dL.

Exposure to lead in soils by children at the OU6 residential and recreational properties was evaluated using the EPA Integrated Exposure Uptake Biokinetic (IEUBK) Model for lead (EPA, 1994a). This model is designed to estimate blood levels of lead in children (under 7 years of age) based on either default or site-specific input values for air, drinking water, diet, dust, and soil exposure. These estimated blood levels of lead are then compared to the established level of concern of 10 μg/dL. An additional step in the process estimates the probability that blood-lead levels will exceed 10 μg/dL. EPA's stated goal for lead is that individuals exposed would have no more than a 5 percent probability of exceeding the level of concern of 10 μg/dL.

The results of the property-specific lead exposure evaluations are discussed in Section 3. The input parameters used and the results of lead models, estimated blood-lead levels, and probability density histograms are presented in Appendix B-10.

2.7.5.4 Asbestos Evaluation

Quantitative risk estimates (inhalation risk estimates) have not been developed for asbestos in this HHRA. EPA considers asbestos to be a carcinogen for exposures through the inhalation pathway. EPA has published a carcinogenic inhalation unit risk toxicity factor for quantitative cancer risk estimates for asbestos; however, this factor is in units of fibers/ml in ambient air. Use of the EPA unit risk factor requires either measurements of asbestos in air or measurements of the expected amount of asbestos released to the air in respirable dust from asbestos-contaminated soil. At this site, no data are available for asbestos concentrations in air or dust. Recently, a method for measurements of the expected amount of asbestos released to the air in respirable dust from asbestos-contaminated soil has been developed. The accuracy of this method has not been verified and, therefore, EPA has not yet accepted the method for risk assessment and risk management purposes. Asbestos in soil at this site has been reported as a percentage in soil and was measured by a visual microscopic evaluation of the percentage of a soil sample that is comprised of asbestos fibers. This data is insufficient for quantitative risk assessment because it is highly subjective and cannot be used to predict air or dust concentrations.

Asbestos-containing material is defined as material containing more than one percent asbestos (Appendix A to Subpart M of 40 CFR61) (EPA, 1990). Asbestos is considered a potential inhalation hazard if it is “friable” (can be crumbled, pulverized, or reduced to powder) and, consequently, subject to entrainment/migration into the air. For this reason, the definition of asbestos-containing material was used for qualitative evaluations of asbestos exposures.

The presence of pavement and/or vegetative cover at each property reduces the potential for airborne asbestos. Based on field conditions at the OU6 properties, it is likely that asbestos does not currently present a significant inhalation risk from the estimated areas of Raymark waste at the OU6 properties. The asbestos contained in soils may become friable under dry conditions and may become a health concern through inhalation exposures to fibers in dust from the site. Disturbances of asbestos-containing soils through excavation or other human activities will increase the potential for airborne asbestos exposures and associated inhalation risks.

2.7.6 Uncertainties Analysis

There are uncertainties associated with all HHRAs. This section summarizes these uncertainties, and discusses how they may affect the final risk estimates discussed in Section 3.

There is uncertainty associated with all steps of the risk assessment process. Uncertainty in the data evaluation is associated with sampling adequacy, the current status of the predictive databases for development of screening values, the procedures used to include or exclude constituents as chemicals of potential concern, and the methods used and the assumptions made to determine exposure point concentrations. The selection of chemicals of potential concern is based on exposure assumptions and toxicity information, which in turn have associated uncertainties. Uncertainty associated with the exposure assessment includes the values used as input variables for a given intake route and the predictions regarding future land use and population characteristics. Uncertainty in the toxicity assessment includes the quality of the existing data to support dose-response relationships and the weight-of-evidence used for determining the carcinogenicity of chemicals of concern. Uncertainty in risk characterization includes that associated with exposure to multiple chemicals and the cumulative uncertainty from combining conservative assumptions made in earlier activities.

While there are various sources of uncertainty (as described above) throughout the risk assessments, assumptions were made so that the final calculated risks would be conservative estimates that are protective of public health. Thus, the resultant uncertainty in the numerical risk assessments is in how much lower the actual risks are.

Generally, risk assessments carry two types of uncertainty: measurement and informational uncertainty. Measurement uncertainty refers to the variance that can be attributed to sampling techniques and laboratory analysis of contaminants. For example, this type of uncertainty is associated with analytical data collected for each site. The risk assessment reflects the accumulated variances of the individual values used. Informational uncertainty refers to estimates of toxicity and exposure. Often this gap is significant, such as the absence of information on the effects of human exposure to low doses of a chemical, the biological mechanism of action of a chemical, or the behavior of a chemical in soil.

Once the risk assessment is complete, the results must be reviewed and evaluated to identify the type and magnitude of uncertainty involved. Reliance on results from a risk assessment without considering uncertainties, limitations, and assumptions inherent in the process can be misleading. For example, to account for uncertainties in the development of exposure assumptions, conservative estimates must be made to ensure that the particular assumptions made are protective of sensitive subpopulations or the maximum exposed individuals. If a number of conservative assumptions are combined in an exposure model, the resulting calculations can propagate the uncertainties associated with those assumptions, thereby producing a much larger uncertainty for the final results. This uncertainty is biased toward over-predicting both carcinogenic and non-carcinogenic risks. Thus, both the results of the risk assessment and the uncertainties associated with those results must be considered when making risk management decisions.

This interpretation is especially relevant when the risks exceed the point-of-departure for defining "acceptable" risk. For example, when risks calculated using a high degree of uncertainty are below an "acceptable" risk level (1E-6), the interpretation of no significant risk is straightforward. However, when risks calculated using a high degree of uncertainty are above an "acceptable" risk level (1E-4), a conclusion can be difficult unless uncertainty is considered. The risk estimates alone may indicate unacceptable risk; however, if uncertainty is biased toward over-predicting risk, actual risks could fall within acceptable range.

The OU6 risk assessments use exposure and toxicity assumptions from the "high end" of their distributions. These values correspond to the RME scenarios.

Uncertainties within the components of the HHRA are discussed below.

2.7.6.1 Uncertainty in Data Evaluation

Uncertainty is associated with analytical data collected and analyzed for each site. This risk assessment evaluates exposures to individuals limited to portions of each property where samples met the definition of Raymark waste. Portions of the property not meeting the definition of Raymark waste are not included in this evaluation. Any uncertainty associated with the estimated extent of Raymark waste present at a property is thus propagated through

the risk assessment. This uncertainty not only affects which samples are included in datasets for each property, but also the exposure assessment, which relies on prorating of exposure intake based on the percentage of a property estimated to contain Raymark waste. There is uncertainly associated with identification of samples that meet the definition of Raymark waste. The source of this uncertainty is the limited analyses performed on some samples and the margin of error in reporting laboratory results.

As discussed in Appendix D, some of the data are the results of field-screening methods, rather than EPA-approved methods. Unvalidated field-screening data for metals were included in the HHRA. A correlation study, comparing field-screening data to CLP data was performed and is presented in Appendix B-3. The correlation study concluded that field-screening data for metals were comparable to CLP data. However, there was a poor statistical correlation between field-screening data and CLP data for PCBs.

This is not unexpected, since the analytical techniques used in the mobile laboratory for PCB analysis differ from the techniques used in fixed laboratories. Detection limits for PCBs vary greatly between the two sets of data. Field-screening data were collected for use in defining the estimated areas of Raymark waste and are useful for that purpose. As discussed in Appendix B-3, the field-screening data and CLP data were analytically comparable only if one considers the question of whether or not concentrations of PCBs are above 1,000 µg/kg.

For this reason, field-screening data for metals, but not PCBs, were included in this HHRA. Typically, environmental samples analyzed in the field in “real time” may result in slight differences from those analyzed in a fixed-base laboratory. Because one half the detection limit is used as a proxy for non-detected results in determining mean concentrations and 95 percent UCLs, and detection limits for metals in the field screening analyses are higher than in CLP analysis, metals data (copper and lead) including samples analyzed in the field may result in slightly higher exposure point concentrations. Due to the high degree of correlation between field-screening data and CLP data for metals shown in Appendix B-3 and the exclusion of field-screening data for PCBs due to poor statistical correlation with CLP results, it is unlikely that use of the field-screening data contributes significantly to the overall uncertainty of the risk assessment. At most, it may result in risks that are slightly higher than actual conditions. The exclusion of field-screening data for PCBs limits the quantitative risk assessments for some

properties where no samples within the estimated areas of Raymark waste were analyzed for PCBs by CLP methods.

There is a minor amount of uncertainty associated with the selection of COPCs in the quantitative risk assessment. Conservative screening values were used to select COPCs; thus, it is unlikely that any contaminant that may pose a risk was eliminated from the risk assessment. There were chemicals detected for which EPA has little or no information regarding the chemical's toxicity. Without any measure of toxicity, there is often very little that can be done to quantitatively address the potential hazard that the chemical may pose. Furthermore, there are many compounds that are not part of EPA's routine list of analytes. If a compound is not on EPA's routine analyte list, it most likely will not be reported even if present in the environment. This too can have an impact on the selection of chemicals of potential concern.

COPCs were selected if the maximum detected concentration in soils exceeded its respective risk-based screening criterion. Even if the compound was detected at a very low frequency, i.e., less than 5 percent, if the maximum detected concentration exceeded the screening criterion, the compound was still retained for evaluation in the risk assessment. Based on a review of the data, the absence of using frequency of detection as a COPC selection criterion did not result in a significant increase in the number of COPCs evaluated in this risk assessment. Therefore, this does not significantly contribute to the uncertainty of the risk assessment.

Background concentrations were not used to eliminate COPCs. A discussion of uncertainty associated with background concentrations is provided in Section 3 for individual properties where appropriate.

Uncertainty arises from calculation of exposure point concentrations. For several of the OU6 properties, datasets from estimated areas of Raymark waste consisted of small numbers of samples. Additionally, not all samples were analyzed for all potential COPCs. This makes the estimation of the upper 95 percent confidence limit on the mean highly uncertain and, therefore, the maximum detected chemical concentrations were often used to assess RME risks. As a result, the estimations of risk where maximum concentrations were used as

exposure concentrations are most likely overstated because it is unlikely that potential receptors would be exposed to the maximum concentration over the entire exposure period.

The inclusion of soils currently located at depths of as much as 15 feet bgs in the calculation of exposure point concentrations may overestimate current risk to commercial workers, residents, or recreational visitors who do not contact soils at depth. These samples were included to address concerns for future exposures when excavation or construction may bring these soils to the surface.

2.7.6.2 Uncertainty in the Exposure Assessment

Uncertainty in the exposure assessment arises from determination of land use conditions, selection of receptors, and selection of exposure parameters. Each is discussed below.

Exposure Routes and Receptor Identification. Exposure routes and receptor groups were based on discussions with the EPA. This may either under- or over-estimates the risks, with the final result dependent on how well the receptors were defined.

Selection of Exposure Parameters. Each exposure factor selected for use in this risk assessment has some associated uncertainty. Generally, exposure factors are based on surveys of physiological and lifestyle profiles across the United States. The attributes and activities studied in these surveys generally have a broad distribution. To avoid underestimation of exposure, EPA guidelines on the RME receptor were used that generally consist of the 95th percentile for most parameters. Therefore, the selected values for the RME receptor represent the upper bound of the observed or expected habits of the majority of the population.

Many of the exposure parameters were determined from statistical analyses on human population characteristics. Often the database used to summarize a particular exposure parameter (body weight) is quite large. Consequently, the values chosen for such variables in the RME scenario have low uncertainty. For many parameters for which limited information exists (dermal absorption of organic chemicals from soil), there is greater uncertainty.

Many of the quantities used to calculate exposures and risks in this report are selected from a distribution of possible values. For the RME scenario, the value representing the 95th percentile is generally selected for each parameter to ensure that the assessment bounds the actual risks from a postulated exposure.

An additional exposure parameter representing the fraction of a property estimated to contain Raymark waste (FRW) was included in the risk calculations. The resulting risks do not represent the total risks to which a receptor will be exposed unless one assumes soil at other portions of the property is totally clean and that receptors use all areas of the property on an equal basis. Therefore, reasonable maximum risks presented in this risk assessment underestimate risks to receptors who spend a disproportionate amount of their time within the estimated areas of Raymark waste or who contact contaminants in other portions of the property. If one were to assume that a receptor spent all his/her time in the estimated areas of Raymark waste, it would be necessary to remove the FRW factor from the intake equations. The resulting risk estimates would increase proportionally. Appendix B-12 presents a summary of cancer risks, hazard indices, and lead evaluation results with and without the FRW factor.

2.7.6.3 Uncertainty in the Toxicological Evaluation

A toxicity evaluation is a chemical's hazard identification and dose-response assessment. The hazard identification deals with characterizing the nature and strength of the evidence of causation, or the likelihood that a chemical that induces adverse effects in animals will also induce adverse effects in humans. Hazard identification of carcinogenicity is an evaluation of the weight-of-evidence that a chemical causes cancer. Positive animal cancer test data suggest that humans contain tissue(s) that may also manifest a carcinogenic response; however, the animal data cannot necessarily be used to predict the target tissue in humans. In the hazard assessment of non-cancer effects, however, positive animal data suggest the nature of the effects (the target tissues and type of effects) anticipated in humans.

Uncertainty in hazard assessment arises from the nature and quality of the animal and human data. Uncertainty is reduced when similar effects are observed across species, strain, sex, and exposure route; when the magnitude of the response is clearly dose-related; when

pharmacokinetic data indicate a similar fate in humans and animals; when postulated mechanisms of toxicity are similar for humans and animals; and when the chemical of concern is structurally similar to other chemicals for which the toxicity is more completely characterized.

Uncertainty in the dose-response evaluation includes determining a slope factor for the carcinogenic assessment and deriving an RfD for the non-carcinogenic assessment. The slope factor is an upper bound estimate of the human cancer risk per milligram of contaminant per milligram of body weight per day. The RfD is an estimate with uncertainty (spanning perhaps an order of magnitude of daily exposure to humans) below which a person is likely to be without appreciable risk of adverse effect over a lifetime. Uncertainty is introduced from interspecies (animal to human) extrapolation, which, in the absence of quantitative pharmacokinetic or mechanistic data, is usually based on consideration of interspecies differences in basal metabolic rate. Uncertainty also results from intraspecies variation. Most toxicity experiments are performed with animals that are similar in age and genotype so that intragroup biological variation is minimal, but the human population of concern may reflect a great deal of heterogeneity, including unusual sensitivity or tolerance to the COPC. Even toxicity data from human occupational exposure reflect a bias because only those individuals sufficiently healthy to attend work regularly (the "healthy worker effect") and those not unusually sensitive to the chemical are likely to be occupationally exposed.

Finally, uncertainty arises from the quality of the key study from which the quantitative estimate is derived and from the database. For cancer effects, the uncertainty associated with dose-response factors is mitigated by assuming the 95 percent upper bound for the slope factor. Another source of uncertainty in carcinogenic assessment is the method by which data from high doses in animal studies are extrapolated to the dose range expected for environmentally exposed humans. The linearized multistage model, which is used in nearly all quantitative estimations of human risk from animal data, is based on a nonthreshold assumption of carcinogenesis. There is evidence to suggest, however, that epigenetic carcinogens, as well as many genotoxic carcinogens, have a threshold below which they are non-carcinogenic (William and Weisburger, 1991); therefore, the use of the linearized multistage model is conservative for chemicals that exhibit a threshold for carcinogenicity.

Use of the cancer slope factor for dioxins of 1.5E+5 $(mg/kg/day)^{-1}$ from IRIS (EPA, 2003) may underestimate risks from exposure to dioxins. USEPA has prepared a Draft Dioxin Reassessment (EPA, 2000), which recommends a CSF for dioxins of 1.0E+6 $(mg/kg/day)^{-1}$. Appendix B-9 presents the cancer risks for site exposures to dioxins using the dioxin CSF of 1.0E+6 $(mg/kg/day)^{-1}$. Cancer risks estimated using this approach are approximately an order of magnitude greater than risks calculated using the CSF for dioxins of 1.5E+5 $(mg/kg/day)^{-1}$.

For non-cancer effects, additional uncertainty factors may be applied in deriving the RfD to mitigate poor quality of the key study or gaps in the database. Additional uncertainty for non-cancer effects arises from the use of an effect level in estimating an RfD, because this estimation is predicated on the assumption of a threshold below which adverse effects are not expected. Therefore, an uncertainty factor is usually applied to estimate a no-effect level. Additional uncertainty arises in estimating an RfD for chronic exposure from less-than-chronic data. Unless empirical data indicate that effects do not worsen with increasing duration of exposure, an additional uncertainty factor is applied to the no-effect level in the less-than-chronic study. Uncertainty in deriving RfDs is mitigated by the use of uncertainty and modifying factors that normally range between 3 and 10. The resulting combination of uncertainty and modifying factors may reach 1,000 or more.

The derivation of dermal RfDs and CSFs from oral values may cause uncertainty. This is particularly the case when no gastrointestinal absorption rates are available in the literature or when only qualitative statements regarding absorption are available.

Uncertainty also arises in the dose-response assessment for values derived for several principal chemicals of concern by using studies with limitations. For example, Class B2 PAHs for which no toxicity data are available are evaluated using benzo(a)pyrene toxicity data with estimated orders of potential potency. This may either underestimate or overestimate the carcinogenic risks associated with PAHs.

Uncertainty is associated with the exclusion of copper from the quantitative risk assessment. EPA Region I does not generally quantitatively evaluate non-carcinogenic hazards posed by copper because of the lack of an approved toxicity value (RfD). EPA Region IX PRGs for copper are based on a provisional oral RfD, which was based on concentrations needed to

protect against a deficiency of the compound, rather than on quantitative estimates related to the hazard posed by overexposure (EPA, 1999b). Copper is a major contaminant at these properties. Exclusion of copper from this risk assessment may result in an under estimate of non-carcinogenic risks. Qualitative comparisons of site-specific copper concentrations to the EPA Region IX PRG for copper are included in the Section 3 uncertainty discussions, wherever the EPA Region IX PRG was exceeded.

Some uncertainty is associated with the evaluation of chromium, which was assumed to be present in its hexavalent state. Since hexavalent chromium is considered to be more toxic than the trivalent state, which is more common, risks for this chemical are probably overestimated to some degree.

Uncertainty is associated with evaluating exposures to lead. Two methods have been used in this risk characterization to evaluate lead exposures. Exposures of children to lead were evaluated using EPA's IEUBK model. Uncertainty is associated with the use of default values for exposures to lead via pathways other than soil ingestion. The IEUBK model was developed based on children exposed in a residential scenario. Exposures of commercial workers to lead are evaluated by use of the EPA Technical Review Workgroup Model for lead. This approach focuses on estimating fetal blood-lead concentrations in women exposed to lead contaminated soils in non-residential scenarios. Uncertainty is associated with estimating maternal blood-lead concentrations and with the relationship between maternal blood-lead concentrations and fetal blood-lead concentrations.

Uncertainty is associated with the lack of a quantitative evaluation of inhalation exposures to asbestos. Risks from exposures to asbestos are not quantified due to a lack of toxicity values and reliable models for predicting air concentrations of asbestos from soil concentrations. A qualitative evaluation of asbestos is included for each of the OU6 properties.

Uncertainty in the final calculations of risk results from assumptions made regarding additivity of effects from exposure to multiple compounds from various exposure routes. High uncertainty exists when cancer risks for several substances are summed across different exposure pathways. This assumes that each substance has a similar effect and/or mode of action. Often compounds affect different organs, have different mechanisms of action, and

differ in their fate in the body, so additivity may not be an appropriate assumption. However, the assumption of additivity was made to provide a conservative estimate of risk.

Finally, the risk characterization does not consider antagonistic or synergistic effects. Little or no information is available to determine the potential for antagonism or synergism for the COPCs. Therefore, this uncertainty cannot be discussed for its impact on the risk assessment, since it may either underestimate or overestimate potential human health risk.

Property-specific uncertainties are discussed in Section 3.

2.8 Ecological Risk Evaluation

The objective of the ecological evaluation is to describe the present environmental conditions at each property prior to potential impacts from remedial action activities. If implemented, remedial activities may result in the unavoidable loss of onsite ecological resources. Mitigation or restoration goals would need to be established if important ecological resources (e.g., wetlands, streams, threatened or endangered species) are present in an area designated for remedial action. To help establish goals in the event onsite resources are unavoidably degraded or lost during any response actions, an evaluation of the current site conditions and site flora and fauna is necessary.

An ecological evaluation includes a description of the property and its ecological habitats. The ecological evaluation in this RI does not include an assessment of site contamination, potential risk to ecological receptors, or a description of the ecological habitats of the areas surrounding the commercial properties because property specific sampling of the surroundings (insects, animals, sediments, soils) was not performed. However, given the fact that the properties are all located within the Town of Stratford and are all contaminated with the same waste material, generalizations of the impact of the contaminated waste material on the environment can be made. The ecological conditions were evaluated in the general area of some of the properties under the OU3 RIs. This is referenced in the property write-ups in Section 3 for:

- Lockwood Avenue Property
- 200 Ferry Boulevard

- 230 Ferry Boulevard
- 250 Ferry Boulevard
- 280 Ferry Boulevard
- 300 Ferry Boulevard
- Lot Behind 326 Ferry Boulevard
- Vacant Lot at Housatonic Avenue
- 326 Ferry Boulevard
- Beacon Point Area
- 1 Beacon Point Road
- 575 East Broadway
- 600 East Broadway
- CT Right of Way

However, none of these properties had a site-specific ecologic assessment of the property field conditions; therefore the property by property write-ups in Section 3 are general in nature. Any ecological impacts on a property will be evaluated during the design and cleanup of a parcel, if needed.

2.8.1 General Ecological Setting

The study area consists of 24 properties. The 24 properties consist of developed and undeveloped land. Many of the properties consist of buildings surrounded by paved parking lots with some landscape plantings that provide little wildlife habitat.

The habitat types associated with the undeveloped properties are characteristic of disturbed areas in New England. Much of the area surrounding the study area consists of commercial, industrial, and residential properties with minimal habitat values, with the exception of the Housatonic River and its associated wetlands.

Vegetation along the bank and wetlands of Ferry Creek is dominated by common reed. The upland bank along Ferry Creek typically has a narrow tree line with a dense understory of shrubs and vines. Ferry Creek flows into the Housatonic River.

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The Housatonic River is used for recreational fishing, shellfishing, and boating. The mouth of the Housatonic River is considered to be a recreational fishery and a potential source of human food-chain organisms. Coastal waterways are assumed to support various recreational activities, as well as recreational and commercial fishing. The lower Housatonic River, near the mouth of Ferry Creek, contains important commercial seed beds for oyster cultivation. EPA representatives have observed people collecting crabs from the Ferry Creek flood control barrier located on Broad Street.

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3.0 PROPERTY EVALUATIONS

This section presents individual property discussions for each of the 24 parcels where Raymark waste has been identified and which form the basis for this report. Each property is discussed using the general framework for preparing remedial investigation reports provided in the EPA guidance (EPA, 1988). All of the discussions are property-specific and include activities currently underway, a physical description of the setting, the nature and extent of known contamination, the assumed contaminant movement, a presentation of the human health and ecological risk assessments, and a summary of the findings.

3.1 Lockwood Avenue Property

This property is one of the 24 properties evaluated in this report (see Figure 1-2). Raymark waste has been found in fill materials on this property. See Section 3.1.3 for a table detailing the soil sample locations determined to contain Raymark waste at this property.

3.1.1 Property Description

This property, approximately 5.3 acres of commercially-zoned (partly waterfront business and partly retail) land, is located east of Lockwood Avenue and Ferry Boulevard in Stratford, Connecticut (Town of Stratford, 1997). The property is unoccupied and undeveloped, and contains no structures. The property is vegetated with common reed in the wetland areas and trees and shrubs in the upland areas. A soil berm is present along Lockwood Avenue and along a portion of Ferry Creek. Potential asbestos waste materials have been observed on the soil berm surface. No storm drains were observed on the property.

Public access to the area is not restricted, although signs discouraging trespassing due to the presence of a potential health threat were posted by the Stratford Health Department. Broad Street is located to the north, with Ferry Creek and the Housatonic River to the east, residential properties on Stratford Avenue to the south, and commercial and residential properties on Lockwood Avenue to the west.

Ferry Creek is connected to Selby Pond by a concrete drainage culvert (approximately 18-inch diameter) that runs through this property (east to west direction). All tidal water entering and leaving Selby Pond passes through this culvert. Reportedly, dredge spoils from past dredging operations in Ferry Creek were deposited on this property. Approximately 60 percent of the area is tidal wetlands, with the remaining area consisting of undeveloped uplands.

3.1.2 Physical Characteristics

According to Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps for Stratford, Connecticut, this property is located within the 100-year floodplain of the Housatonic River. The 100-year frequency base flood elevation for the two zones located on the property is

10 and 12 feet (FEMA, 1992). See Figure 1-2 for the boundary of the floodplain on this property.

Twenty-one borings (SB-312S, SB-312D, and SB-312B; B2-SB01 through B2-SB09; and DBL-101 through DBL-109) were advanced on the property to depths of up to 124 feet below ground surface (bgs). Soil boring SB-312B was advanced to bedrock at 90.5 feet bgs and cored into bedrock. Soils noted in borings DBL-101 and DBL-107 through DBL-109 consist of organic materials characteristic of a former marsh and swamp deposit. Fill materials were not identified in the soil from these borings. Soils noted in borings B2-SB01 through B2-SB03, B2-SB05, B2-SB08, B2-SB09, and DBL-102 through DBL-105 consist of fill overlying a former marsh and swamp deposit. The soils encountered below the fill include peat and organic silt. In borings B2-SB04 and B2-SB07, the organic materials overlie glacial outwash and/or ice-contact deposits. In boring DBL-106, silt mixed with asbestos fibers was observed. Refer to Figure 3-1 for boring locations on the property. Boring logs are presented in Appendix A.

One well cluster, MW-312, was installed on this property; borings SB-312S, SB-312D, and SB-312B were completed as monitoring wells. No soil samples were collected from SB-312S and SB-312D. Soil sample locations are shown on Figure 3-1, and include both shallow surface soil samples and deeper samples from the soil borings. The borings were used to describe the fill and native material on the property. All soil sampling locations were used to determine the presence or absence of Raymark waste and identify the locations that exceed the Connecticut RSRs.

Fill on this property consists of both natural and manmade materials placed on the property as a result of human activity. Manmade materials, including potentially asbestos-containing materials (PACM) (asbestos boards, mats, and pads), asphalt, asphalt shingles, brick, clay pipe, cloth, concrete, glass, plastic, slag, sludge-like processed waste, manufacturing debris, and a tar/rubber-like substance were identified in the soil from one or more of the borings. PACM was identified in the soil from borings B2-SB01, B2-SB02, B2-SB05, DBL-103, DBL-104, and DBL-106. The manmade materials were encountered with natural fill materials consisting of sand, with varying amounts of silt and/or gravel, and silt with organic matter. Manmade debris was not identified in borings B2-SB06, B2-SB07, B2-SB09, DBL-101, and DBL-107 through DBL-109. Fill classifications were based on the visual characteristics of soil and sediment samples that were collected during the field investigations. Based on interpretations and field

observations, fill was identified in borings across the entire property. The depth to water was 1 foot to 10 feet bgs, based on the soil moisture content recorded on the boring logs and on 2003 water level measurements from monitoring wells on the property.

Raymark waste was found in fill materials on this property. The lateral limits of the areas of Raymark waste have been estimated by the presence of asbestos, lead, copper and/or Aroclor 1268 meeting the definition of Raymark waste, as defined in Section 2.2 of this report. These limits are shown on Figure 3-1. The estimated areas of Raymark waste make up approximately 34 percent of the property, and are primarily located in the central and southern portions of the property. Approximately 60 percent of the total property is considered tidal wetlands (shown on Figure 1-2). The estimated area of Raymark waste is within the wetland portion of the property with the exception of the small area that abuts Lockwood Avenue. This area is mostly soils in the berms and is vegetated with small shrubs and trees.

3.1.3 Nature and Extent of Contamination

Contaminant concentrations in all soil samples collected at this property were compared to the Connecticut RSRs (CT DEP, 1996) to determine the potential impact of the contaminants on soils and groundwater and to provide an understanding of relative contaminant concentrations throughout the property. Results of samples from all depths, including those collected from below the water table, were compared to the direct exposure criteria (CT DEC) for commercial/industrial land use and to the pollutant mobility criteria (CT PMC) for GB areas. CT DECs are regulatory criteria for soil based predominantly on risk from exposures via the ingestion pathway with consideration given to background concentrations, detection limits, and ceiling limits. Comparison of individual property contaminant data to CT DEC serves to evaluate the potential for contaminants in soils to present a risk to human health. CT PMCs are regulatory criteria for soil based on ambient water quality criteria and modeling the migration of contaminants from soil to groundwater. Comparison of individual property contaminant data to CT PMC serves to evaluate the potential for contaminants in soils to impact groundwater quality.

There were 138 samples collected from 56 locations on this property. Sample locations, with exceedances of the CT DEC and CT PMC, are indicated on Figure 3-1. Samples were analyzed

for asbestos, dioxins, metals, SPLP metals, pesticides, PCBs, SVOCs, and VOCs. See Table 3-1 for the number of samples analyzed for each contaminant.

A summary of the nature and extent of soils contamination is discussed below by contaminant group. See Table 3-1 for the soil summary statistics and comparison to criteria. The evaluation focuses on contaminants whose concentrations exceed the CT DEC and/or CT PMC. Figure 3-1 also depicts the CT DEC and/or CT PMC criteria exceedances on the property. A complete set of soil analytical results for each property is provided in Appendix C. The discussion below includes all soil samples collected on the property, not just those determined to be within the estimated areas of Raymark waste.

Asbestos

One hundred and twenty-one samples were collected from the property and analyzed for asbestos. Asbestos was detected very frequently on the property. Asbestos at greater than 1 percent was detected in 44 of 121 samples. Asbestos detections were scattered throughout the property at depths ranging from ground surface to 14 feet bgs.

Dioxins

Sixteen soil samples were collected from the property for dioxin analysis. Dioxins were detected in all of the samples. Dioxin concentrations are expressed as Toxicity Equivalents (TEQ) values. See Section 3.5.2.5 for an explanation of TEQ. TEQ values ranged from 0.001935 µg/kg to 0.351 µg/kg.

Metals

Soil samples were collected from the property and analyzed for metals as follows: 36 samples were analyzed at a fixed laboratory for metals; 71 were screened for copper; and 95 were screened for lead. Metals were detected frequently on the property. Some metals are components of essential nutrients, occur naturally, or are present at such low concentrations that they are considered to be of low concern. These metals include aluminum, calcium, iron, magnesium, potassium, and sodium. Four metals exceeded the CT DEC regulatory standards;

arsenic, beryllium, chromium, and lead. Metals exceedances were located in the central and southern portions of the property from the ground surface to 10 feet bgs.

SPLP and TCLP Metals

Seven soil samples were also collected for SPLP metals analysis. Cadmium, chromium, copper, and lead exceeded the CT PMC regulatory standards, indicating the potential for leaching into groundwater. The SPLP exceedances were scattered throughout the property, from the ground surface to 6 feet bgs. Based on the data provided in Appendix C for this property, only two out of the seven SPLP samples were from within the estimated area of Raymark waste. Both samples exceeded the CT PMC for lead. No TCLP samples were collected.

Pesticides

Thirty-six soil samples were collected from the property for pesticide analysis. Pesticides were detected fairly frequently on the property. Dieldrin was the only pesticide exceeding the CT DEC. Sixteen soil samples exceeded the CT PMC regulatory standards for pesticides. Pesticide exceedances were located in the central and southern portions of the property from the ground surface to 8 feet bgs.

PCBs

Up to 79 soil samples were collected from the property for analysis of PCBs as Aroclors. PCBs were often detected on the property. Five samples exceeded the CT DEC regulatory standards for Total Aroclors. The PCB exceedances were located in the central and southern portions of the property from the surface to 6 feet bgs. Aroclor 1268 was the primary contributor to total Aroclor exceedances at three of the locations, SB-09, DBL-104 and DBL-106, at depths ranging from ground surface to 4 feet bgs; Aroclor 1254 was the primary contributor to total Aroclor exceedances at B2-SB02 and DBL-103, from 4 to 6 feet bgs. No samples were collected for SPLP PCB analysis.

SVOCs

Thirty-two soil samples were collected from the property for SVOCs analysis. SVOCs were detected frequently on the property. Fourteen samples exceeded the CT DEC and/or CT PMC regulatory standards for SVOCs. SVOC exceedances were scattered throughout the property, from the ground surface to 8 feet bgs.

VOCs

Seventeen soil samples were collected from the property for VOC analysis. VOCs were very rarely detected on the property. There were no VOC exceedances of the CT DEC or the CT PMC regulatory standards.

Raymark Waste

The results from 14 sample locations at multiple depths indicate that Raymark waste is present on the property. The following table displays the locations and contaminant concentrations for the 17 samples from those 14 locations that meet the definition of Raymark waste on this property. These samples are located within the 34 percent of the property shown on Figure 3-1 as the "Estimated Area of Raymark Waste within Property of Interest".

Sample Location	Depth Interval (ft bgs)	Asbestos (%)	Lead (mg/kg)	Copper (mg/kg)	Aroclor 1268 (µg/kg)
DBL-008	0 to 0.5	50	1,470	NA	8,000
DBL-009	0 to 0.5	50	1,860	NA	6,000
DBL-010	0 to 0.5	10	760	NA	7,000
DBL-010	0 to 0.5	10	730	NA	7,000
DBL-012	0 to 0.5	10	880	NA	8,000
DBL-020	0 to 0.5	5	410	NA	2,000
DBL-023	0 to 0.5	40	1,210	NA	2,000
DBL-104	0 to 2	4	1,310	491	17,000
	2 to 4	3	450	230	4,300
DBL-106	0 to 2	15	415	307	8,600
B2-SB02	2 to 4	3	540	370	NA
	6 to 8	5	600	1,000	NA
B2-SB03	2 to 4	30	1,200	580	NA
	6 to 8	20	576	318	480
B2-SB05	6 to 8	10	10,600	7,870	2,200
B2-SB06	2 to 4	3	691	899	2,600
B2-SB09	2 to 4	20	1,700	2,520	7,200

NA- Contaminant was not analyzed

3.1.4 Fate and Transport

Section 2.6 discusses the general approach to contaminant fate and transport and the mechanisms governing fate and transport of contaminants from areas with Raymark waste. The primary pathways for migration of contaminants throughout this property are discussed below.

Approximately 34 percent of the 5.3-acre property is estimated to contain Raymark waste, shown on Figure 3-1 as the "Estimated Area of Raymark Waste within Property of Interest". Most of the waste areas on the property are heavily vegetated with phragmites and other wetland vegetation, with the exception of the waste areas abutting the road. The portion of the property abutting Lockwood Avenue consists of soil berms and is vegetated with shrubs and trees. Approximately 90 percent of the areas estimated to contain Raymark waste are located in the center of the property, while two smaller areas of waste are located along the southern and eastern boundaries of the property.

The wetland on the property contains Raymark waste; some of the waste areas abut both Ferry Creek and the Housatonic River. These wetlands also contain channels that receive tidal water and prevent flooding on the property. The wetlands are vegetated with reeds, thus slowing any overland transport of the sediments. The soils on the parcel are also vegetated, thus slowing any erosion of contaminants into the wetlands on the property or onto Lockwood Avenue.

There are no buildings or paved areas on the property, therefore, contaminants on the property may leach into the surface water and groundwater. For this property, as indicated by the SPLP and other data, metals, pesticides, and SVOCs could potentially leach into the groundwater at concentrations that would adversely impact groundwater quality.

3.1.5 Baseline Human Health Risk Assessment

This section contains the baseline human health risk assessment (HHRA) performed for the portion of the parcel located at the Lockwood Avenue Property that was found to contain Raymark waste in soil. Data collected from this parcel, but beyond the estimated areas of Raymark waste, while useful in the delineation of Raymark waste, were not included in this risk evaluation. Soil exposures and the resulting risk estimates have thus been prorated based on

the percentage of the property estimated to contain Raymark waste (FRW shown in Table 1-1). Risk estimates for exposures to the estimated areas of Raymark waste are limited by the extent of sample collection and analysis from locations within the estimated areas of Raymark waste themselves. The use of the FRW in calculations of risk assumes that receptors use all areas of the property on an equal basis. Total risks associated with the exposure to the entire parcel may be higher than presented in this HHRA if contaminants beyond the estimated areas of Raymark waste are present or if receptors spend a higher percentage of their time within the estimated areas of Raymark waste than that assumed in Table 1-1. A more detailed discussion of the HHRA approach is presented in Section 2.7. Section 3.1.5.1 provides an overview of the Lockwood Avenue Property, Section 3.1.5.2 presents COPCs and EPCs, Section 3.1.5.3 contains information on the potential receptors considered in the HHRA and the routes by which they might be exposed, Section 3.1.5.4 contains the numerical results of the risk assessment, and Section 3.1.5.5 presents property-specific uncertainties. Section 3.1.5.6 presents a property-specific summary of the major risk findings.

3.1.5.1 Overview

The Lockwood Avenue Property is zoned as a partial waterfront business/partial retail property, but it is currently undeveloped. As described in the SRI report, a hotel/marina complex has been proposed as a possible future use of the property. The area covers approximately 5.3 acres. A detailed description of the Lockwood Avenue Property is provided in Section 3.1.1. The areas of the Lockwood Avenue Property estimated to contain Raymark waste represent an estimated 34 percent of the total 5.3-acre property and are shown in Figure 3-1. Property-specific site conditions within the estimated areas of Raymark waste are described in Section 3.1.2. Listings of samples included in the risk evaluation are presented in Appendix B-2. Descriptive statistics (frequency of detection, range of positive detections, range of non-detects, location of maximum detections, and arithmetic mean) for the target analytes detected in soils within the estimated areas of Raymark waste are summarized in Appendix B-1, Table 2.1.

3.1.5.2 Data Evaluation

The COPC selection process for soil is summarized in Section 2.7.2. Appendix B-1, Table 2.1 presents a summary of the COPCs for quantitative risk assessment for the Lockwood Avenue Property soils from the estimated areas of Raymark waste to a depth of 15 feet bgs. Direct

exposure COPCs were identified based on a comparison of site data from the estimated areas of Raymark waste to the COPC screening levels defined in Section 2.7.2. All validated CLP data were used to identify COPCs. Screening data were also used for metals.

Direct Exposure COPCs

Maximum detections in soil were compared to COPC screening levels based on EPA Region IX PRGs for soils. As discussed in Section 2.7.2, EPA Region I recommends the use of EPA Region IX PRGs for COPC selection (EPA, 1994c). EPA Region IX PRGs are risk-based screening criteria. Soil data were compared to both industrial and residential COPC screening levels in order to address two different potential future uses of the Lockwood Avenue Property. Those chemicals with concentrations exceeding the industrial COPC selection criteria were selected as COPCs for the commercial worker evaluation. Those chemicals with concentrations exceeding the residential COPC selection criteria were selected as COPCs for the recreational visitor evaluation. The following chemicals were identified as direct exposure COPCs based on a comparison of maximum concentrations in soils at the estimated areas of Raymark waste at this property to risk-based COPC screening levels for commercial land use, as shown in Appendix B-1, Table 2.1A:

- Asbestos
- PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h) anthracene, and indeno(1,2,3-cd)pyrene)
- Aroclors, total (1248, 1254, 1262, and 1268)
- Dieldrin
- Metals (antimony, arsenic, cadmium, chromium, thallium, and lead)
- Dioxins

The following chemicals were identified as direct exposure COPCs based on a comparison of maximum concentrations in soils at the estimated areas of Raymark waste of this property to risk-based COPC screening levels for residential land use, as shown in Appendix B-1, Table 2.1B:

- Asbestos

- PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h) anthracene, and indeno(1,2,3-cd)pyrene)
- Aroclors, total (1248, 1254, 1262, and 1268)
- Dieldrin
- Metals (antimony, arsenic, barium, cadmium, chromium, manganese, nickel, thallium, vanadium, zinc, and lead)
- Dioxins

Exposure Point Concentrations

The methods used to identify appropriate exposure point concentrations are described in Section 2.7.2. Exposure point concentrations used in the risk assessment for the Lockwood Avenue Property are presented in Appendix B-1, Tables 3.1A and 3.1B. Support documentation for the calculation of dioxin TEQ concentrations is presented in Appendix B-4. Support documentation for the calculation of 95 percent UCLs for COPCs is presented in Appendix B-5.

3.1.5.3 Exposure Assessment

The exposure assessment contains a discussion of the potential for human exposure at the Lockwood Avenue Property and identifies the rationale for the selection of exposure input parameters used to estimate exposure intakes. A detailed description of the potential receptors, exposure routes, and intake estimation methods used in the exposure assessment is presented in Section 2.7.3. Area-specific information regarding exposure is provided in this section.

Under future conditions, potential human receptors (commercial workers and recreational visitors) are assumed to be exposed to soil only within the estimated areas of Raymark waste at the property under reasonable maximum exposure (RME) conditions.

Land Use and Access

The Lockwood Avenue Property is currently an undeveloped area, zoned for waterfront business and retail use, as described in Section 3.1.1. A hotel/marina complex has been proposed as a possible future use of the property.

Potential Receptors

The receptors retained for quantitative evaluation at the Lockwood Avenue Property are future commercial workers and future recreational visitors. Potentially exposed individuals under the commercial scenario are limited to those who may work at the property in the future. Potentially exposed individuals under the recreational scenario include residents who may live nearby or visitors from other areas of Stratford or surrounding towns.

Possible exposures of commercial workers to site-related contaminants would be through inadvertent contact during commercial/industrial activities at the property. Under the future land use, commercial workers were evaluated for exposure to soils (0 to 15 feet bgs) at a limited area (soils within the estimated areas of Raymark waste) only. Appendix B-1, Table 4.1 presents the exposure assumptions for commercial workers at this and other commercial properties in the RI.

Frequent recreational visitors are evaluated for exposure to soils (0 to 15 feet bgs) in the estimated areas of Raymark waste, under future land use. Persons involved in recreational activities (the frequent recreational visitor) may visit the estimated areas of Raymark waste at Lockwood Avenue Property, thereby coming in contact with potentially contaminated soil. Possible exposures of frequent visitors to site-related contaminants would be through recreational activities, such as walking, or picnicking. Appendix B-1, Table 4.3A presents the exposure assumptions for adult recreational visitors at this and other recreational properties in the RI. Appendix B-1, Table 4.3B presents the exposure assumptions for child recreational visitors at this and other recreational properties in the RI.

Exposure Pathways

The primary routes of exposure for potential human receptors at the Lockwood Avenue Property are incidental ingestion of, and dermal contact with, soil. Potential exposure to volatile emissions and fugitive dust from the property is considered to be minimal. Qualitative evaluations of the inhalation pathway are provided below. The estimated areas of Raymark waste are heavily vegetated with either phragmites or small shrubs and trees. The presence of vegetation reduces the likelihood of inhalation exposures.

A qualitative comparison of maximum detected soil concentrations and EPA Generic SSLs for inhalation, based on inter-media transfer from soil to air (EPA, 1996a), was performed to determine if additional quantitative analysis of this potential exposure pathway was warranted. The inhalation SSLs are based on residential land use and lifetime exposure scenarios and are therefore relatively conservative values for potential receptors at commercial and recreational properties. Appendix B-1, Tables 2.1A and 2.1B present available inhalation SSLs for contaminants in soils at the estimated areas of Raymark waste at the Lockwood Avenue Property.

With the exception of those reported for total chromium and dieldrin, all reported soil concentrations are less than the EPA Generic SSLs for transfers from soil to air (EPA, 1996a). One sample result out of 15 exceeded the SSL_{AIR} for dieldrin and four sample results out of 15 exceeded the SSL_{AIR} for hexavalent chromium. The average dieldrin concentration detected in the Raymark waste soil samples (190 µg/kg) is less than the SSL_{AIR} for dieldrin (1000 µg/kg). The maximum detected concentration in the Raymark waste soil samples (3270 mg/kg) and the average total chromium concentration detected in the Raymark waste soil samples (410 mg/kg) are greater than the SSL_{AIR} for hexavalent chromium (280 mg/kg). Assuming that the maximum total chromium concentration represents only hexavalent chromium and comparing this maximum concentration to the SSL_{AIR} for chromium, the maximum concentration corresponds to a cancer risk level of approximately 1.2E-05 for residential receptors. This risk level is within EPA's cancer risk range of 10^{-4} to 10^{-6}.

Further evaluation of site-specific total chromium concentrations relative to inhalation SSLs for commercial/industrial land use (EPA, 2001a) reveals that the average total chromium concentration detected in the Raymark waste soil samples (410 mg/kg) is less than the commercial/industrial SSL_{AIR} for hexavalent chromium (510 mg/kg). The maximum detected concentration in the Raymark waste soil samples (3270 mg/kg) is greater than the commercial/industrial SSL_{AIR} for hexavalent chromium (510 mg/kg). Assuming that the maximum total chromium concentration represents only hexavalent chromium and comparing this maximum concentration to the SSL_{AIR} for chromium, the maximum concentration corresponds to a cancer risk level of approximately 6E-06 for commercial/industrial receptors. This risk level is within EPA's cancer risk range of 10^{-4} to 10^{-6}.

The SSL_{AIR} for chromium assumes that chromium is present in the hexavalent state. The assumption that all chromium is in the hexavalent state is likely to be a conservative assumption.

A qualitative evaluation of potential inhalation risks from exposures to asbestos is presented in Section 3.1.5.4. Asbestos is present in soils within the estimated areas of Raymark waste at the Lockwood Avenue Property. The presence of vegetation and the qualitative comparison to SSLs, suggest that exposures to fugitive dust and volatile emissions are currently insignificant, thereby eliminating the need for quantitative evaluation of this exposure pathway.

Estimates of Chemical Intake

Estimates of chemical intake were calculated using equations presented in Section 2.7.4. Appendix B-1, Table 4.1 contains the various assumptions used as input parameters to determine chemical intakes for commercial workers through ingestion and dermal contact. Appendix B-1, Table 4.3A and Table 4.3B contain the various assumptions used as input parameters to determine chemical intakes for adult and child recreational visitors through ingestion and dermal contact. In order to prorate exposures, the fraction of the property estimated to contain Raymark waste (FRW) is factored into the intake equations shown in Section 2.7.3.4. Table 1-1 presents the property sizes and FRW values for each property. The FRW for the Lockwood Avenue Property is 0.34. Chemical intake estimates for the commercial scenario at the property are provided in Appendix B-1, Tables 7.1A and 8.1A. Chemical intake estimates for the recreational scenario at the property are provided in Appendix B-1, Tables 7.1B, 7.1C, 8.1B, and 8.1C.

3.1.5.4 Risk Characterization

The methods used to estimate the type and magnitude of potential human health risks associated with the exposures to COPCs in soils are described in Section 2.7.5. A summary of the quantitative risk assessment for the Lockwood Avenue Property is provided in this section. For the commercial scenario, Appendix B-1, Table 7.1A and Table 8.1A present non-cancer and cancer RME risk estimates, respectively. Appendix B-1, Tables 7.1B and 8.1B present non-cancer and cancer RME risk estimates for adult recreational visitors. Appendix B-1, Tables 7.1C and 8.1C present non-cancer and cancer RME risk estimates for child recreational visitors.

Children represent the more sensitive population for non-cancer risks. For cancer risks the risks to children and adults are added to produce an estimate of risks from lifetime recreational exposures. Sample calculations are provided in Appendix B-6. Total non-carcinogenic and carcinogenic risks for each exposure route, as well as the cumulative risk, are summarized in Appendix B-1, Tables 9.1A, 9.1B, and 9.1C. Appendix B-1, Tables 10.1A, 10.1B, and 10.1C reduce the information developed in Appendix B-1, Tables 9.1A, 9.1B, and 9.1C to the major risk drivers. Results of the evaluations of lead exposures are presented in Appendix B-10.

Non-Carcinogenic Risks

RME hazard indices developed for the commercial worker and the recreational visitor at the Lockwood Avenue Property were as follows:

	Ingestion	Dermal	Total
Commercial Worker (Future)	1.3	0.87	2.1
Frequent Recreational Visitor – Adult (Future)	0.78	0.32	1.1
Frequent Recreational Visitor – Child (Future)	7.2	2.1	9.3

The RME hazard indices (HI) for the commercial worker and for both the child and the adult frequent recreational visitors exposed to soils within the estimated areas of Raymark waste at the property are in excess of unity. Total Aroclor was the main contributor to the hazard index for the commercial worker. Total Aroclor and chromium were the main contributors to the hazard index for the frequent recreational visitors. The chemical-specific (and target-organ specific) hazard quotients for total Aroclor alone are in excess of unity for both commercial receptors and recreational receptors. The chemical-specific (and target-organ specific) hazard quotients for total chromium alone are in excess of unity for recreational receptors. Adverse non-carcinogenic health effects are possible from exposure to Aroclors and chromium. See Tables 7.1A RME, 7.1B RME, and 7.1C RME in Appendix B-1 for details on non-cancer hazard index calculations.

Carcinogenic Risks

Incremental RME cancer risk estimates for the commercial worker and the recreational visitor at the Lockwood Avenue Property were as follows:

	Ingestion	Dermal	Total
Commercial Worker (Future)	2.9E-05	2.0E-05	4.8E-05
Frequent Recreational Visitor – Adult[(1)] (Future)	1.7E-05	6.8E-06	2.3E-05
Frequent Recreational Visitor – Child[(1)] (Future)	3.9E-05	1.1E-05	5.0E-05

1) Summation of total risk for Frequent Recreational Visitors (adult plus child): 7.3E-05.

The EPA cancer risk range is 10^{-4} to 10^{-6}. The CT DEP target cancer risk level is 10^{-6} for single contaminants and 10^{-5} for total risk from multiple contaminants. Cancer risks for the frequent adult and child recreational visitor are added together for a lifetime exposure. The RME risk estimates for the commercial worker and the frequent recreational visitors exposed to soils at the estimated areas of Raymark waste at the Lockwood Avenue Property fall within the EPA cancer risk range (10^{-4} to 10^{-6}), but exceed the CT DEP target total risk level of 10^{-5} for multiple contaminants. See Tables 8.1A RME, 8.1B RME, and 8.1C RME in Appendix B-1 for details on cancer risk calculations. As detailed on Appendix B-1, Table 9.1A, dioxins, Aroclors, arsenic, and the PAH compounds (benzo(a)pyrene and dibenzo(a,h)anthracene) are the predominant risk drivers for the commercial scenario, with estimated cancer risks greater than the CT DEP target risk level for single contaminants of 10^{-6}. As detailed on Appendix B-1, Tables 9.1B and 9.1C, dioxins, Aroclors, arsenic, dieldrin, and the PAH compounds (benzo(a)pyrene and dibenzo(a,h)anthracene) are the predominant risk drivers for the recreational scenario, with estimated cancer risks greater than the CT DEP target risk level for single contaminants of 10^{-6}. In addition to the above risks, cancer risks from inhalation of chromium in dust may be as great as 6E-6 for commercial workers and 1.2E-5 for recreational visitors (see discussion in Section 3.1.5.3).

Cancer risk estimates for dioxins, shown on the tables referenced above and included in the discussion above, were calculated using the CSF for 2,3,7,8-TCDD of 1.5E+5 $(mg/kg/d)^{-1}$ from IRIS (EPA, 2003). As discussed in Section 2.7.4.2, this CSF is undergoing EPA review. Cancer risk estimates for dioxins calculated using the CSF for dioxins of 1E+6 $(mg/kg/d)^{-1}$ from the Draft Dioxin Reassessment (EPA, 2000) are presented in Appendix B-9. Total cancer risks estimated using the Draft Dioxin Reassessment CSF for dioxin for commercial workers exposed to soils within the estimated area of Raymark waste at this property are 7.3E-05. Total cancer risks

estimated using the Draft Dioxin Reassessment CSF for dioxin for recreational visitors exposed to soils within the estimated area of Raymark waste at this property are 1.1E-04.

Exposure to Lead

Lead was identified as a COPC in soils within the estimated areas of Raymark waste at the Lockwood Avenue Property. Lead was detected in samples collected from 0 to 15 feet bgs within the estimated areas of Raymark waste at a maximum concentration of 10,600 mg/kg. The average lead concentration in this dataset was 785 mg/kg.

Exposure to lead in soil by the commercial worker was evaluated by use of a slope-factor approach developed by the EPA Technical Review Workgroup for Lead (EPA, December 1996d), as discussed in Section 2.7.4.7. The exposure point concentration of 785 mg/kg for soils within the estimated areas of Raymark waste at the property was used to estimate the probability that the fetal blood-lead levels of fetuses born to workers exposed to lead in a commercial setting will exceed 10 µg/dL. In order to prorate exposures, the fraction of the property estimated to contain Raymark waste (FRW) is factored into the intake equations shown in Appendix B-10. The FRW for the Lockwood Avenue Property is 0.34. EPA's stated goal for lead is that individuals exposed would have no more than a 5 percent probability of exceeding the level of concern of 10 µg/dL. Under the commercial scenario for the estimated areas of Raymark waste at the property, the range of probabilities that the fetal blood-lead concentration exceeds 10 µg/dL is 0.5 to 1.2 percent. The input parameters used and the results of lead models are presented in Appendix B-10.

Exposure to lead in soil by the frequent child recreational visitor was evaluated using the EPA IEUBK Model, as discussed in Section 2.7.4.7. The IEUBK model was developed to evaluate exposures to lead by children in a residential setting. Consequently, using the IEUBK model for child recreational exposures should provide a very conservative evaluation of exposures to lead. The time-weighted exposure point concentration of 267 mg/kg (average lead concentration for soil within the estimated areas of Raymark waste of 785 multiplied by the FRW of 0.34), as well as several default parameters, was used to estimate blood-lead levels for children in a residential setting. The estimated geometric mean blood-lead level for children exposed to lead in soils within the estimated areas of Raymark waste was 4.0 µg/dL, which is less than the established level of concern of 10 µg/dL. The IEUBK model estimates that 2.5 percent of

children exposed to lead in soils at the estimated areas of Raymark waste at the property are expected to have blood-lead levels greater than 10 µg/dL, which is less than the acceptable level of 5 percent. The input parameters used and the results of the IEUBK lead models, estimated blood-lead levels, and probability density histograms are presented in Appendix B-10.

Exposure to Asbestos

Asbestos was detected in 41 of 52 soil samples collected from the estimated areas of Raymark waste at a concentration range of 1 to 50 percent. These samples were collected from the 0- to 15-foot bgs interval. The average concentration was 7 percent. Although quantitative risk estimates (inhalation risk estimates) have not been developed for this parameter, it should be noted that asbestos-containing material is defined as material containing more than 1 percent asbestos (Appendix A to Subpart M of 40 CFR 61) (EPA, 1990). Asbestos is considered a potential inhalation hazard if it is "friable" (can be crumbled, pulverized, or reduced to powder) and, consequently, subject to entrainment/migration into the air.

The presence of vegetative cover in the estimated areas of Raymark waste reduces the potential for airborne asbestos from the Lockwood Avenue Property. Based on field conditions in the estimated areas of Raymark waste at the property, it is likely that asbestos does not currently present a significant inhalation risk from the estimated areas of Raymark waste at this property. If asbestos containing soils are disturbed, the potential for airborne asbestos exposure and associated inhalation risks exists.

3.1.5.5 Uncertainties

A detailed discussion of uncertainties associated with the various aspects of risk assessment, in general, was provided in Section 2.7.6. Area-specific uncertainties for the Lockwood Avenue Property are presented in the following narrative.

- Uncertainty associated with the extent of the estimated areas of Raymark waste adds uncertainty in the risk assessment. The associated uncertainties propagate through the risk assessment, not only in which samples are included in the evaluation, but also in the exposure assessment, which relies on prorating of exposure intake based on the percentage of the property estimated to contain Raymark waste. Uncertainty in the

identification of samples meeting the definition of Raymark waste includes accuracy and precision of the analytical methods. Limitations in the determination of the areal extent of Raymark waste for each property are discussed in Section 3.3.

- The use of the FRW factor in prorating exposures assumes that individual receptors will spend time within the estimated areas of Raymark waste in direct proportion to the percent of the property estimated to contain Raymark waste. The total area of the Lockwood Avenue Property is 5.3 acres, with an estimated 34 percent containing Raymark waste. A physical description of the estimated areas of Raymark waste at the property is provided in Section 3.1.4. The estimated areas of Raymark waste are heavily vegetated with phragmites or small shrubs and trees. No consideration has been given to site characteristics other than the presence of buildings. It is conceivable that individuals may spend all of their time within the estimated areas of Raymark waste. In this case, because risks were estimated assuming individuals would only be exposed to contaminated soils 34 percent of the time, reasonable maximum risks for exposure to the estimated areas of Raymark waste would be approximately three times greater than those estimated using the FRW factor.

- Soil concentrations in background locations are discussed in Section 2.5.3 and presented in Table 2-2. Average background concentrations are also shown in Appendix B-1, Table 2.1, alongside site-specific data from the estimated areas of Raymark waste. Arsenic, with an average background concentration of 5.67 mg/kg, was detected at concentrations ranging from 2.6 to 56 mg/kg, with an average concentration of 12 mg/kg. Risks due to arsenic may be attributable to background conditions.

- Dioxins were selected as COPCs. Since new toxicological information has become available, cancer risks based on the CSF of 1.5×10^5 $(mg/kg/day)^{-1}$ may underestimate risks. Cancer risks from dioxins based on the proposed CSF of 1.0×10^6 $(mg/kg/day)^{-1}$ for dioxins are presented in Appendix B-9. These risks are approximately an order of magnitude greater than risks estimated using the CSF of 1.5×10^5 $(mg/kg/day)^{-1}$.

- Fifty-seven samples were included in the dataset for soils within the estimated areas of Raymark waste; however, 42 of those samples were only analyzed by field-screening methods. Due to limited numbers of samples analyzed for dioxins, PAHs

(benzo(a)anthracene, benzo(b)fluoranthene, dibenzo(a,h)anthracene), and antimony, maximum concentrations were used to evaluate risks for these parameters. The use of maximum concentrations and small datasets adds uncertainty to the risk estimates.

- In the absence of chromium speciation data, toxicity values for chromium VI were used to estimate risks from measured total chromium concentrations. Since hexavalent chromium is considered to be more toxic than the trivalent state, which is more common, risks for this chemical are probably overestimated to some degree.

- A comparison of soils data from the property outside the estimated areas of Raymark waste to CT RSRs is provided in Appendix B-10. The presence of arsenic, chromium, acetophenone, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, Aroclors, and dieldrin at concentrations greater than CT RSRs for industrial soil suggests that risks from other areas of the property may be of concern. Arsenic is present outside the estimated areas of Raymark waste at the Lockwood Avenue Property at concentrations up to 13.8 mg/kg, chromium is present at concentrations up to 126 mg/kg, acetophenone is present at concentrations up to 0.05 mg/kg, benzo(a)anthracene is present at concentrations up to 10 mg/kg, benzo(a)pyrene and benzo(b)fluoranthene are present at concentrations up to 13 mg/kg, dibenzo(a,h)anthracene is present at concentrations up to 1.1 mg/kg, dieldrin is present at concentrations up to 1.7 mg/kg, and Aroclors are present at concentrations up to 133 mg/kg. The individual Aroclors detected are Aroclors 1254, 1262, and 1268. Dioxins were detected outside the estimated areas of Raymark waste; however, no CT RSRs are available for dioxins. Dioxin TEQ concentrations outside the estimated areas of Raymark waste exceed EPA Region IX PRGs for industrial soil in two samples. Asbestos is present outside the estimated areas of Raymark waste at the Lockwood Avenue Property at concentrations up to 30 percent. Lead and copper are also present outside of the estimated areas of Raymark waste at the property, with maximum concentrations of 820 mg/kg and 1,100 mg/kg, respectively. Thus, a commercial worker's exposure and risk from the entire property are likely to be greater than that estimated for the areas of Raymark waste alone.

3.1.5.6 Summary of Human Health Risk Assessment

This section presents a summary of major risk assessment findings for soils estimated to contain Raymark waste at the Lockwood Avenue Property. Risks to future commercial workers and both child and adult recreational visitors were estimated.

- The RME hazard indices (HI) for future commercial workers and both child and adult recreational visitors exposed to soil within the estimated areas of Raymark waste at the property are in excess of unity. The chemical-specific (and target organ-specific) hazard quotients for total Aroclor and chromium alone are in excess of unity. Adverse non-carcinogenic health effects are possible from exposures to Aroclors and chromium.

- The RME cancer risk estimates for future commercial workers and both child and adult recreational visitors exposed to soil within the estimated areas of Raymark waste at the property fall within the EPA cancer risk range (10^{-4} to 10^{-6}) but exceed the CT DEP target total risk level of 10^{-5}. Dioxins, Aroclors, arsenic, dieldrin, and the PAH compounds (benzo(a)pyrene and dibenzo(a,h)anthracene) are the predominant risk drivers, with estimated cancer risks greater than the CT DEP target risk level for single contaminants of 10^{-6}.

- Exposure to lead in soil by commercial workers was evaluated by use of a slope-factor approach developed by the EPA Technical Review Workgroup for Lead (EPA, December 1996d). The results of the slope-factor approach indicate that adverse effects are not anticipated for fetuses of pregnant workers exposed to lead in soil within the estimated areas of Raymark waste at the property.

- Exposure to lead in soil by child recreational visitors was evaluated by use of the IEUBK model. The results of the model indicate that adverse effects are not anticipated for child recreational visitors exposed to lead in soil within the estimated areas of Raymark waste at the property.

- Asbestos was detected in 41 of 52 soil samples collected from the estimated areas of Raymark waste at the Lockwood Avenue Property in the 0- to 15- foot bgs interval at a concentration range of 1 to 50 percent. The average concentration was 7 percent.

3.1.6 Ecological Evaluation

The ecological characterization of the wetlands on this property was addressed under the OU3 Area II RI (TtNUS, 2000a) and is presented in the *Draft Technical Memorandum Wetlands Evaluation, Raymark – Ferry Creek – OU3* (B&RE, 1998). A summary of the findings is presented below. It should be noted however, that no individual evaluation of the ecological impacts on this property was performed.

Most of the area has been significantly disturbed by surrounding development, past uses of Ferry Creek, and filling of wetlands. The wetland areas on the property are dominated by common reed. Upland areas are primarily covered with small trees and shrubs, especially along the soil berm ridge. Woody upland vegetation consists of staghorn sumac (*Rhus typhina*) and quaking aspen. Observations indicate that dredge spoils from Ferry Creek have been deposited in the wetland.

The 1998 wetland evaluation identified six functions exhibited by the vegetated portion of these wetlands. These include flood/flow alteration, sediment shoreline stabilization, sediment/ toxicant retention, groundwater recharge/discharge, nutrient export, and nutrient removal/retention/ transformation.

The property can provide foraging, cover, resting, and breeding habitat for a variety of song and shore birds, small mammals, and reptiles. However, the habitat quality is limited because of the surrounding development, soil contamination, disturbed nature of the area, and the low vegetation diversity. Wildlife identified utilizing the wetland include red-winged blackbird (*Agelaius phoeniceus*) and green heron (*Butorides striatus*). Other wildlife utilize nearby Ferry Creek and are identified in the Wetland Evaluation (B&RE, 1998b).

3.1.7 Summary

This 5.3-acre property abutting the Ferry Creek and Housatonic River confluence contains Raymark waste. Samples containing metals (including total metals and SPLP metals), pesticides, PCBs and SVOCs that exceed CT DEC and/or CT PMC criteria, and asbestos greater than 1 percent are present on the property. Given the current undeveloped property conditions, infiltration and leaching is likely occurring throughout the property.

RME hazard indices for commercial workers and recreational visitors exposed to soil within the estimated areas of Raymark waste indicate that adverse non-carcinogenic health effects are possible. The RME cancer risk estimates fall within the EPA cancer risk range, but exceed the CT DEP target total risk level. Dioxins, Aroclors, arsenic, dieldrin, benzo(a)pyrene, and dibenzo(a,h)anthracene are the predominant risk drivers. Adverse effects are not anticipated for fetuses or pregnant workers exposed to lead in soil within the estimated areas of Raymark waste. The average asbestos concentration was 7 percent in the estimated areas of Raymark waste.

Ecological risks were presented in the OU3 Area II RI (TtNUS, 2000a).

TABLE 3-7
LOT BEHIND 326 FERRY BOULEVARD - SOIL ANALYTICAL RESULTS **
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
REMEDIAL INVESTIGATION
RAYMARK - OU6
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Average Detected Conc.	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Industrial) (1) (2)	Number of Exceedances of CT DEC (1) (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)
Asbestos (%)										
Amosite	1	1	1	1	1	1				
Asbestos	70	86	8	10	0.9	60	1	52		
Chrysotile	1	1	19	19	19	19				
Dioxin (UG/KG)										
1,2,3,4,6,7,8-HpCDD	2	6	0.61	0.48	0.0676	0.886				
1,2,3,4,6,7,8-HpCDF	3	6	2.4	4.4	0.0568 EMPC	12.96 &				
1,2,3,4,7,8,9-HpCDF	2	6	0.32	0.057	0.0033 J	0.111				
1,2,3,4,7,8-HxCDD	1	6	0.21	0.017	0.017	0.017				
1,2,3,4,7,8-HxCDF	3	6	0.94	1.5	0.0049	4.62 &				
1,2,3,6,7,8-HxCDD	3	6	0.29	0.034	0.0044 EMPC	0.0854				
1,2,3,6,7,8-HxCDF	2	6	0.4	0.78	0.0028 J	1.56				
1,2,3,7,8,9-HxCDD	2	6	0.29	0.031	0.0043 J	0.0568				
1,2,3,7,8,9-HxCDF	1	6	0.11	0.022	0.022	0.022				
1,2,3,7,8-PeCDD	1	6	0.33	0.011	0.0114 EMPC	0.0114 EMPC				
1,2,3,7,8-PeCDF	2	6	0.39	0.64	0.0013 EMPC	1.27 &				
2,3,4,6,7,8-HxCDF	3	6	0.49	0.59	0.0023 J	1.77 &				
2,3,4,7,8-PeCDF	3	6	0.48	0.8	0.0029 J	2.38 &				
2,3,7,8-TCDD	2	6	0.16	0.0019	0.00039 J	0.0035				
2,3,7,8-TCDF	3	6	0.56	0.89	0.002	2.65 EMPC&				
OCDD	4	6	2.6	3.1	1.08	4.91 J&				
OCDF	3	6	0.73	0.81	0.0255	2.26				
Total HpCDD	3	6	1	1.3	0.165 J	1.93 EMPC&				
Total HpCDF	3	6	2.6	4.9	0.0205 J	14.53 EMPC&				
Total HxCDD	3	6	0.27	0.21	0.0158 J	0.535 EMPC				
Total HxCDF	3	6	3.6	6.9	0.0744 J	20.6 &				
Total PeCDD	2	6	0.39	0.18	0.0017 EMPC	0.359 EMPC				
Total PeCDF	3	6	2.9	5.6	0.0382 JEB	16.85 EMPC&				
Total TCDD	2	6	0.18	0.057	0.0025 JEB	0.111 EMPC				
Total TCDF	3	6	1.9	3.6	0.025 JEB	10.71 EMPC&				
Toxicity Equivalency	5	6	0.59	0.63	0.00292 J	2.48				

TABLE 3-1 (cont.)
LOCKWOOD AVENUE PROPERTY - SOIL ANALYTICAL RESULTS **
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
REMEDIAL INVESTIGATION
RAYMARK - OU6
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Average Detected Conc.	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Industrial) (1) (2)	Number of Exceedances of CT DEC (1) (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)
Metals (MG/KG)										
Aluminum	36	36	12000	12000	3220	38900 J				
Antimony	6	22	7.2	17.1	1.1 J	51.4	8200	0		
Arsenic	31	36	7.7	8.7	1.5 J	56	10	6		
Barium	36	36	445	445	5.1	3770 J	140000	0		
Beryllium	20	36	0.59	0.83	0.15	5.6	2	1		
Cadmium	24	36	5.4	7.8	0.22	149	1000	0		
Calcium	26	36	4560	5960	1230	37000 J				
Chromium	32	36	192	212	3.6 J	3270 J	100	9		
Cobalt	36	36	8.5	8.5	1.5	23.8	2500	0		
Copper	63	107	348	489	8.3 J	7870 J	76000	0		
Iron	36	36	23800	23800	3960	68100 J				
Lead	94	131	444	599	5.3 J	10600 J	1000	12		
Magnesium	36	36	7120	7120	1140	31600				
Manganese	36	36	236	236	41.2	722 J	47000	0		
Mercury	20	36	0.4	0.66	0.11 J	2.3	610	0		
Nickel	36	36	41.1	41.1	2.9	457 J	7500	0		
Potassium	27	36	2680	3130	560 J	21700 J				
Selenium	5	36	0.82	1.4	0.7 J	3.7 J	10000	0		
Silver	13	35	0.86	1.2	0.38 J	2.9	10000	0		
Sodium	30	36	8630	10300	304 J	187000 *				
Thallium	2	36	1.3	5.3	2.2	8.4	160	0		
Vanadium	36	36	41.1	41.1	7	224	14000	0		
Zinc	36	36	360	360	10.4 J	5930	610000	0		
Metals (SPLP) (UG/L)										
Aluminum	6	6	35600	35600	12000	72900				
Antimony	4	7	13.7	22.6	5	39.4			60	0
Arsenic	7	7	46.8	46.8	0.99 J	112			500	0
Barium	7	7	771	771	37.2 J	2240 J			10000	0
Beryllium	6	7	4.6	5.4	1.3	13.8			40	0

TABLE 3-1 (cont.)
LOCKWOOD AVENUE PROPERTY - SOIL ANALYTICAL RESULTS **
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
REMEDIAL INVESTIGATION
RAYMARK - OU6
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Average Detected Conc.	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Industrial) (1) (2)	Number of Exceedances of CT DEC (1) (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)
Metals (SPLP) (UG/L) (cont.)										
Cadmium	6	7	24.7	28.8	1.4	121			50	1
Calcium	6	6	93200	93200	18500 J	295000				
Chromium	7	7	516	516	2.2 J	2560 J			500	2
Cobalt	6	6	46.8	46.8	6.4	132				
Copper	7	7	3660	3660	48.5 J	14600 J			13000	1
Iron	6	6	47400	47400	7610 J	112000 J				
Lead	7	7	4740	4740	24.1	14600 J			150	5
Magnesium	6	6	22900	22900	13700	29000				
Manganese	6	6	1390	1390	163 J	4020				
Mercury	3	7	0.52	1.1	0.25 J	2.1			20	0
Nickel	7	7	197	197	3.6	630 J			1000	0
Potassium	6	6	14800	14800	7100	18700 J				
Sodium	6	6	83200	83200	27700	138000				
Thallium	2	7	4.3	8.6	7.8	9.3			50	0
Vanadium	7	7	166	166	2.6	492			500	0
Zinc	6	7	2770	3230	161	10300			50000	0
Semivolatile Organic Compounds (UG/KG)										
2,4-Dimethylphenol	3	31	550	1500	130 J	4100	2500000	0	28000	0
2-Methylnaphthalene	7	31	380	98	23 J	260 J	2500000	0	9800	0
2-Methylphenol	1	31	480	680	680	680	2500000	0	70000	0
4-Methylphenol	4	31	460	380	35	1400	2500000	0	7000	0
Acenaphthene	10	31	380	220	28 J	690 J	2500000	0	84000	0
Acenaphthylene	25	32	740	870	28 J	4300 *	2500000	0	84000	0
Acetophenone	2	5	410	38	25 JEB	50 JEB				
Anthracene	25	32	660	760	33 J	3700	2500000	0	400000	0
Benzaldehyde	3	5	380	36	24 JEB	50 JEB				
Benzo(a)anthracene	30	32	1500	1600	44 J	10000	7800	2	1000	13
Benzo(a)pyrene	30	32	1300	1400	51 J	13000 *	1000	10	1000	10
Benzo(b)fluoranthene	30	32	1800	1900	50 J	13000 *	7800	2	1000	13

TABLE 3-1 (cont.)
LOCKWOOD AVENUE PROPERTY - SOIL ANALYTICAL RESULTS **
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
REMEDIAL INVESTIGATION
RAYMARK - OU6
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Average Detected Conc.	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Industrial) (1) (2)	Number of Exceedances of CT DEC (1) (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)
Semivolatile Organic Compounds (UG/KG) (cont.)										
Benzo(g,h,i)perylene	19	31	660	830	23 J	5300	2500000	0	42000	0
Benzo(k)fluoranthene	29	32	1200	1300	51 J	5700 J	78000	0	1000	12
bis(2-Ethylhexyl)phthalate	20	32	710	900	35 J	10000 *	410000	0	11000	0
Butylbenzylphthalate	2	31	440	60	22 J	99 J	2500000	0	200000	0
Carbazole	20	32	290	290	30 J	1300	290000	0	360	4
Chrysene	30	32	2000	2100	60 J	15000 *	780000	0	1000	13
Dibenzo(a,h)anthracene	21	32	340	280	30 J	1100 J	780	1	1000	1
Dibenzofuran	10	31	390	250	31 J	640 J	2500000	0	5600	0
Diethylphthalate	1	31	440	30	30	30	2500000	0	1100000	0
Dimethylphthalate	1	31	550	2900	2900	2900	2500000	0	1100000	0
Di-n-Butylphthalate	6	31	420	210	22 JEB	600 J	2500000	0	140000	0
Di-n-octylphthalate	1	31	460	120	120 J	120 J	2500000	0	20000	0
Fluoranthene	30	32	3500	3700	100 J	23000	2500000	0	56000	0
Fluorene	17	32	330	370	24 J	1900	2500000	0	56000	0
Indeno(1,2,3-cd)pyrene	29	32	650	680	36 J	4500	7800	0	1000	5
Naphthalene	9	31	390	170	38 J	410	2500000	0	56000	0
N-Nitroso-diphenylamine	1	31	470	410	410 J	410 J	1200000	0	1400	0
Pentachlorophenol	2	31	1100	180	150 J	200 J	48000	0	1000	0
Phenanthrene	30	32	2000	2100	44 J	15000	2500000	0	40000	0
Phenol	5	27	460	380	77 JEB	1200	2500000	0	800000	0
Pyrene	30	32	2600	2800	99 J	20000 *	2500000	0	40000	0
Total PAH	5	5	17000	17000	541	36080				
Volatile Organic Compounds (UG/KG)										
2-Butanone	8	17	86	170	2 J	1300 J	1000000	0	80000	0
Acetone	4	17	120	430	62	1500 J	1000000	0	140000	0
Carbon Disulfide	6	16	11	15	3 J	31	1000000	0	140000	0
Styrene	1	17	9	10	10 J	10 J	1000000	0	20000	0
Toluene	3	17	10	11	1 J	28 J	1000000	0	67000	0

TABLE 3-1 (cont.)
LOCKWOOD AVENUE PROPERTY - SOIL ANALYTICAL RESULTS **
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
REMEDIAL INVESTIGATION
RAYMARK - OU6
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Average Detected Conc.	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Industrial) (1) (2)	Number of Exceedances of CT DEC (1) (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)
Pesticide/PCB (UG/KG)										
4,4'-DDD	10	36	77	240	0.48 J	2100 *	24000	0	29	4
4,4'-DDE	13	36	62	150	0.12 J	1700 *	17000	0	21	4
4,4'-DDT	10	35	39	110	0.35 J	730	17000	0	21	5
Aldrin	5	36	5.8	0.92	0.05 J	3 J	340	0	0.41	3
alpha-BHC	4	36	5.7	0.24	0.14 J	0.36 J	910	0	1.1	0
alpha-Chlordane	16	36	41	88	0.05 J	1200	2200	0	66	2
Aroclor, Total(4)	57	79	4600	6400	20	130000	10000	5		
Aroclor, Total (Conservative)(5)	57	79	5300	7300	186	133410	10000	5		
Aroclor-1248	2	40	150	840	280	1400	10000	0		
Aroclor-1254	13	79	3000	17000	110	130000 *	10000	2		
Aroclor-1260	3	79	170	330	250	500	10000	0		
Aroclor-1260/62	2	27	140	380	250	500				
Aroclor-1262	21	55	640	1500	53 J	5700 J	10000	0		
Aroclor-1268	52	79	1400	2100	20 J	17000 J	10000	1		
delta-BHC	1	36	5.8	0.74	0.74 J	0.74 J	910	0	1.1	0
Dieldrin	15	35	140	310	0.65 J	2600 J	360	2	7	11
Endosulfan I	1	36	6.1	6.1	6.1	6.1	1200000	0	8400	0
Endosulfan Sulfate	6	36	29	110	0.8 J	490	1200000	0	8400	0
Endrin	3	36	13	29	0.35 J	86	610000	0		
Endrin Aldehyde	9	35	51	160	0.39 J	1200	610000	0		
Endrin Ketone	2	36	12	3.6	0.33 J	6.9	610000	0		
gamma-Chlordane	10	33	33	93	0.38 J	840 *#	2200	0	66	1
Heptachlor Epoxide	6	35	5.6	0.33	0.05 J	1 J	630	0	20	0
Total Organic Carbon (MG/KG)										
Total Organic Carbon	10	10	86000	86000	22500	205000				

TABLE 3-1 (cont.)
LOCKWOOD AVENUE PROPERTY - SOIL ANALYTICAL RESULTS **
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
REMEDIAL INVESTIGATION
RAYMARK - OU6
STRATFORD, CONNECTICUT

Qualifier	Definition
#	Possible false positive due to interference
*	From dilution analysis or Estimated Maximum Possible Concentration (Dioxins only)
EB	Equipment blank contamination
EMPC	Estimated Maximum Possible Concentration
J	Quantitation approximate

Notes:

** Analytical results in this table are from samples collected throughout the property, not just the estimated area of Raymark Waste.

(1) Asbestos is included with a criterion of 1% in the CT DEC column for comparison purposes. It's criterion is not a promulagated CT Remediation Standard Regulation.

(2) CT DEC - Direct Exposure Criteria for Residential or Commercial/Industrial Soils. CT Remediation Standard Regulations, January 1996, and additional approved criteria.

(3) CT PMC - Pollutant Mobility Criteria for soils in a GB aquifer area. CT Remediation Standard Regulations, January 1996, and additional approved criteria.

(4) Aroclor, Total is the sum of the results of all detected individual Aroclors.

(5) Aroclor, Total (Conservative) is the sum of the results of all detected individual Aroclors and one half the detection limit of non detected individual Aroclors.

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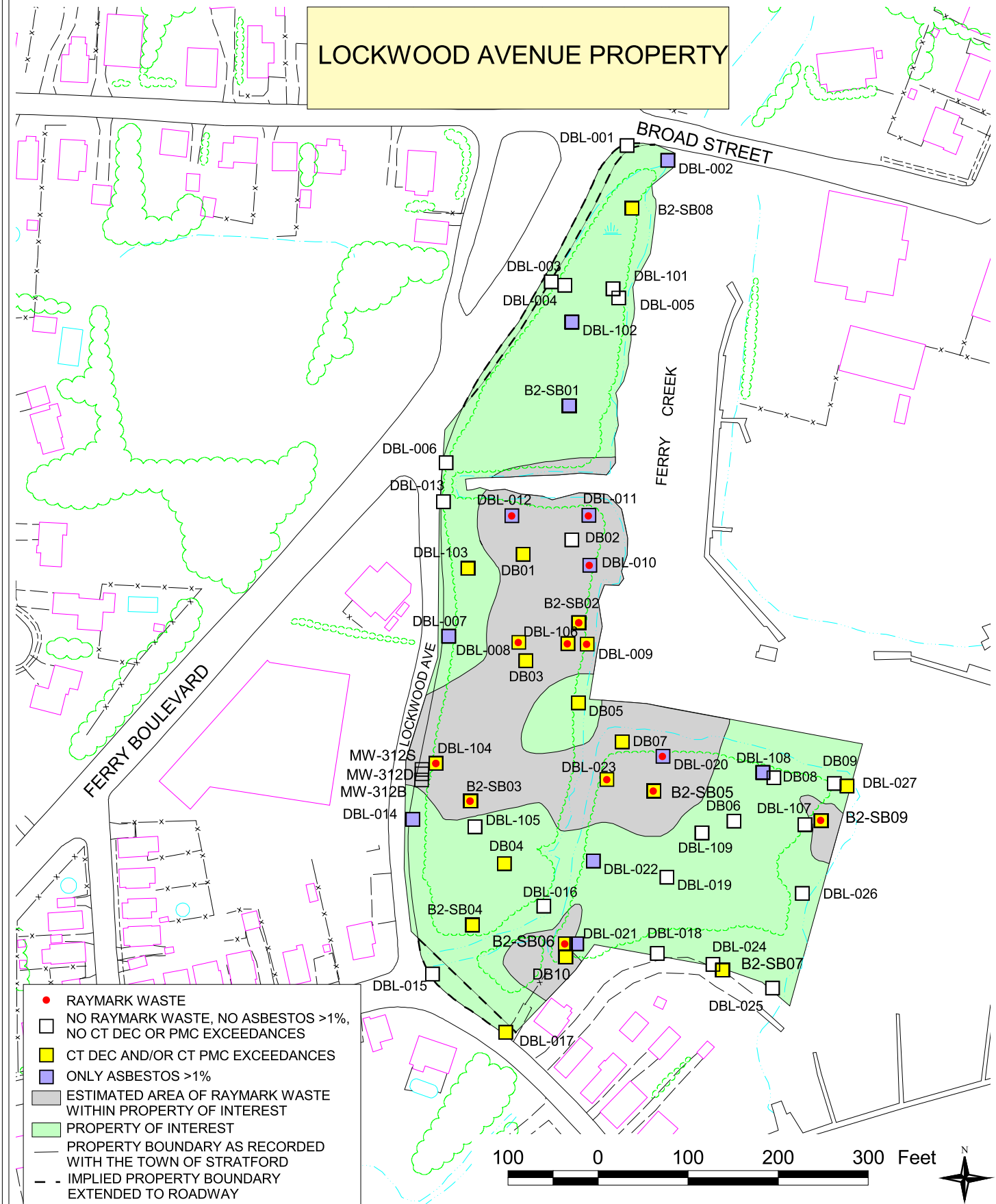

NOTES:
1) PLAN NOT TO BE USED FOR DESIGN
2) ALL LOCATIONS TO BE CONSIDERED APPROXIMATE
3) PROPERTY BOUNDARIES ARE APPROXIMATE BASED ON TOWN OF STRATFORD ENGINEERING DEPARTMENT PLANS
4) DUE TO UNCERTAINTIES OF PROPERTY BOUNDARIES DURING THE SAMPLING PROCESS, SAMPLES LOCATED ADJACENT TO THE PROPERTY ARE UNDERSTOOD TO BE ON THE PROPERTY
5) CT DIRECT EXPOSURE CRITERIA (CT DEC) FOR INDUSTRIAL/COMMERCIAL SOILS AND CT POLLUTANT MOBILITY CRITERIA (CT PMC) USED TO DETERMINE EXCEEDANCES.

SOIL SAMPLE LOCATIONS	FIGURE 3-1
RAYMARK - OU6	
STRATFORD, CONNECTICUT	
DRAWN BY: L. SEYDEWITZ	DATE: APRIL 27, 2004
CHECKED BY: D. CHISHOLM	FILE: C\...\OU6_RI_2003.APR

TETRA TECH NUS, INC.
55 JONSPIN ROAD WILMINGTON, MA 01887
(978)658-7899

3.2 200 Ferry Boulevard

This property is one of the 24 properties evaluated in this report (see Figure 1-2). Raymark waste has been found in fill materials on this property. See Section 3.2.3 for a table detailing the soil sample locations determined to contain Raymark waste at this property.

3.2.1 Property Description

This property, approximately 0.6 acres of commercially-zoned (retail) land, is located on Ferry Boulevard in Stratford, Connecticut (Town of Stratford, 1997). It is currently occupied by two businesses. The two-story wooden building that houses the businesses is located at the northern end of the property. Approximately 80 percent of the area around the building is paved and used for parking. The asphalt pavement is in fair condition with minor cracks. The paved area extends to the tree line along the bank of Ferry Creek where a narrow strip of dense shrub and tree vegetation is present. The topography of this property is flat with a sharp drop off to the Ferry Creek channel. A narrow strip of grass is also present along Ferry Boulevard.

Public access to the area is not restricted, although signs discouraging trespassing in Ferry Creek due to the presence of a potential health threat were posted by the Stratford Health Department. Ferry Creek borders the eastern edge of the property, while a commercial property at 190 Ferry Boulevard borders to the south, Ferry Boulevard borders to the west, and the 230 Ferry Boulevard (see Section 3.3) commercial property borders to the north.

No storm water drains were observed at the property. It appears that surface water drains into Ferry Creek, which lies east of the property.

3.2.2 Physical Characteristics

According to FEMA Flood Insurance Rate Maps for Stratford, Connecticut, portions of this property are located within the 100-year floodplain of the Housatonic River. The 100-year frequency base flood elevation for this property is 10 feet (FEMA, 1992). See Figure 1-2 for the boundary of the floodplain on this property.

Nine soil borings (FB200-101 through FB200-106, SPIM-103, SP-MW103M, and SP-MW103B) have been advanced on the property at 200 Ferry Boulevard. Soils were not described at boring SP-MW103M. Soil borings FB200-101 through FB200-106 and SPIM-103 were advanced to depths up to 16 feet bgs. Soil boring SP-MW103M was advanced to 38.5 feet bgs. Soil boring SP-MW103B was advanced to bedrock and cored into bedrock. Based on the borings, fill materials overlie silt, clayey sand, silty sand, organic silt, or clay. These materials are characteristic of a former marsh and swamp deposit. Organic soils were not encountered in soil boring FB200-104. This boring was terminated before the bottom of fill was determined because the drilling location may have been in a leachfield. Layers of sand, silt, and gravel beneath the former marsh and swamp deposit in boring SP-MW103B are characteristic of outwash sediments. Refer to Figure 3-2 for boring locations on the property. Boring logs are presented in Appendix A.

Two monitoring wells (MW-103B and MW-103M) were installed in the northeast corner of the property to allow for evaluation of groundwater contaminants. No soil samples were collected from MW-103M and it is not shown on Figure 3-2. Soil sample locations are shown on Figure 3-2, including both shallow surface soil samples and deeper samples from soil borings. The borings were used to describe the fill and native material on the property. All sampling locations were used to determine the presence or absence of Raymark waste and identify those locations that exceed the Connecticut RSRs.

Fill on this property consists of both natural and manmade materials that were placed on the property as a result of human activity. Manmade materials encountered in borings included potentially asbestos-containing material (PACM), fibrous tiles, asphalt, ash, concrete, glass, roofing shingles, sludge-like processed-waste, and/or wood. PACM was identified in all of the borings containing manmade material. These materials were encountered with natural fill materials consisting of sand with varying amounts of silt and trace amounts of gravel and clay. Additionally, debris was also observed in the natural organic silt and clay layers encountered in FB200-103 (5.5 to 10 feet bgs) and SP-MW103B (8 to 10 feet bgs). Fill classifications were based on the visual characteristics of the soil samples that were collected during several field investigations. Based on interpretations and field observations, fill was identified in borings across the property. The depth to water on the property ranges from 5 to 9 feet bgs, based on the soil moisture content recorded on the boring logs and on 2003 water level measurements from the monitoring wells on the property.

Raymark waste was found in fill materials on this property. The lateral limits of the area of Raymark waste have been estimated by the presence of asbestos, lead, copper and/or Aroclor 1268 that meet the definition of Raymark waste, as defined in Section 2.2 of this report. These limits are shown on Figure 3-2. Approximately seven percent of the property is estimated to contain Raymark waste. Approximately 70 percent of the estimated area of Raymark waste is paved.

3.2.3 Nature and Extent of Contamination

Contaminant concentrations in all soil samples collected at this property were compared to the Connecticut RSRs (CT DEP, 1996) to determine the potential impact of the contaminants on soils and groundwater and to provide an understanding of relative contaminant concentrations throughout the property. Results of samples from all depths, including those collected from below the water table, are compared to the direct exposure criteria for commercial/industrial soils (CT DEC) and to the pollutant mobility criteria (CT PMC) for GB areas. CT DECs are regulatory criteria for soil based predominantly on risk from exposures via the ingestion pathway with consideration given to background concentrations, detection limits, and ceiling limits. Comparison of individual property contaminant data to CT DEC serves to evaluate the potential for contaminants in soils to present a risk to human health. CT PMCs are regulatory criteria for soil based on ambient water quality criteria and modeling the migration of contaminants from soil to groundwater. Comparison of individual property contaminant data to CT PMC serves to evaluate the potential for contaminants in soils to impact groundwater quality.

There were 77 soil samples collected from 20 locations on this property. Sample locations, with exceedances of the CT DEC and CT PMC, are indicated on Figure 3-2. Samples were analyzed for asbestos, dioxins, metals, SPLP and TCLP metals, pesticides, PCBs, SVOCs and VOCs. See Table 3-2 for the number of samples analyzed for each contaminant.

A summary of the nature and extent of soils contamination is discussed below by contaminant group. The evaluation focuses on contaminants whose concentrations exceed the CT DEC and/or CT PMC. A complete set of soil analytical results for each property is provided in Appendix C. See Table 3-2 for the soil data summary statistics and comparison criteria. The discussion below includes all soil samples collected on the property, not just those determined to be within the estimated area of Raymark waste.

Asbestos

Seventy-seven soil samples were collected from the property and analyzed for asbestos. Asbestos was detected frequently on the property. Asbestos at 1 percent or greater was found in 32 of the 77 samples; these samples were distributed throughout the property from the ground surface to 12 feet bgs.

Dioxins

Five soil samples were collected from the property for dioxin analysis. Dioxins were detected in four of the five samples. Concentrations ranged from 0.010 µg/kg to 0.665813 µg/kg. Dioxin concentrations are expressed as Toxicity Equivalents (TEQ) values. See Section 2.5.2.5 for an explanation of TEQ.

Metals

Soil samples were collected from the property and analyzed for metals as follows: seven samples were analyzed in a fixed laboratory; 37 samples were screened for copper, and 70 samples were screened for lead. Metals were detected frequently on the property. Some metals are components of essential nutrients, occur naturally, or are present at such low concentrations that they are considered not of concern. These metals include aluminum, calcium, iron, magnesium, potassium and sodium. As shown on Table 3-2, chromium exceeded the CT DEC regulatory standard in three samples collected in the northeast area of the property at a depth of 2 to 6 feet bgs.

SPLP and TCLP Metals

Based on the data provided in Appendix C for this property, one soil sample was collected for SPLP metals analysis and one sample for TCLP metals analysis. No SPLP or TCLP samples were collected from within the estimated area of Raymark waste. There were no exceedances of the CT PMC regulatory standard for either analysis.

Pesticides

Six soil samples were collected from the property for pesticides analysis. Pesticides were detected sporadically on the property. There were no CT DEC regulatory exceedances. Four samples exceeded the CT PMC regulatory standards for pesticides. Pesticide exceedances were located in the northeastern portion of the property, from the ground surface to 4 feet bgs.

PCBs

Seventy-three soil samples were collected from the property for analysis of PCBs as Aroclors. PCBs were not detected frequently on the property. There were no PCB exceedances of the CT DEC regulatory standards. There were no SPLP/TCLP samples collected for PCBs on this property.

SVOCs

Five soil samples were collected from the property for SVOCs analysis. SVOCs were detected sporadically on the property. Four SVOCs, primarily PAHs, exceeded the CT DEC and/or CT PMC regulatory standards. SVOC exceedances were located in the northern area of the property, from the ground surface to 6 feet bgs.

VOCs

Five soil samples were collected from this property for VOCs analysis. VOCs were sporadically detected on the property. There were no VOC exceedances of the CT DEC or the CT PMC regulatory standards.

Raymark Waste

The results from two sample locations indicated the presence of Raymark waste on the property. The following table displays the locations and constituents of the two samples with contaminant concentrations that meet the definition of Raymark waste on this property. These samples are located within the 7 percent of the property shown on Figure 3-2 as the “Estimated Area of Raymark Waste within Property of Interest”.

Sample Location	Depth Interval (ft bgs)	Asbestos (%)	Lead (mg/kg)	Copper (mg/kg)	Aroclor 1268 (µg/kg)
FB-200-101	2 to 4	25	438	444	2,700
SPIM-103	2 to 4	10	817	1,100	3,400

3.2.4 Fate and Transport

Section 2.6 discusses the general approach to contaminant fate and transport and the mechanisms governing fate and transport of contaminants from areas with Raymark waste. The primary pathways for migration of contaminants throughout this property are discussed below.

Approximately 7 percent of the 0.6-acre property was estimated to contain Raymark waste. This waste area is near Ferry Boulevard along the western edge of the property and is entirely paved (see Figure 3-2). It is assumed that minimal erosion and moderate leaching is occurring due to cracks in the pavement and the permeability of the pavement. The portion of the property along Ferry Creek is unpaved, but is not within the estimated area of Raymark waste.

The presence of the building in the northern part of the property reduces the leaching potential in that area of the parcel. However, soil data collected from the property indicates that there is a potential for pesticides and SVOCs to leach into groundwater from contaminated soils. According to the SPLP soil data collected, there appears to be little potential for metals to leach into groundwater at concentrations that would adversely impact groundwater quality. Potential leaching is hindered where pavement or building structures are present.

3.2.5 Baseline Human Health Risk Assessment

This section contains the baseline human health risk assessment (HHRA) performed for the portion of the parcel located at 200 Ferry Boulevard that was found to contain Raymark waste in soil. Data collected from this parcel, but beyond the estimated area of Raymark waste, while useful in the delineation of Raymark waste, were not included in this risk evaluation. Soil exposures and the resulting risk estimates have thus been prorated based on the percentage of the property estimated to contain Raymark waste (FRW shown in Table 1-1). Risk estimates for exposures to the estimated area of Raymark waste are limited by the extent of sample collection and analysis from locations within the estimated area of Raymark waste itself. The use of the

FRW in calculations of risk assumes that receptors use all areas of the property on an equal basis. Total risks associated with the exposure to the entire parcel at 200 Ferry Boulevard may be higher than presented in this HHRA if contaminants beyond the estimated area of Raymark waste are present or if receptors spend a higher percentage of their time within the estimated area of Raymark waste than that assumed in Table 1-1. A more detailed discussion of the HHRA approach is presented in Section 2.7. Section 3.2.5.1 provides an overview of the 200 Ferry Boulevard property, Section 3.2.5.2 presents COPCs and EPCs, Section 3.2.5.3 contains information on the potential receptors considered and the routes by which they might be exposed, Section 3.2.5.4 contains the numerical results of the risk assessment, and Section 3.2.5.5 presents property-specific uncertainties. Section 3.2.5.6 presents a property-specific summary of the major risk findings.

3.2.5.1 Overview

200 Ferry Boulevard is a commercial property of approximately 0.6 acres. A detailed description of 200 Ferry Boulevard is provided in Section 3.2.1. The nature and extent of the contamination detected at 200 Ferry Boulevard is discussed in Section 3.2.3. The area of 200 Ferry Boulevard estimated to contain Raymark waste represents an estimated 7 percent of the total 0.6-acre property, exclusive of any buildings, and is shown in Figure 3-2. Property-specific site conditions within the estimated area of Raymark waste are described in Section 3.2.2. Listings of samples included in the risk evaluation are presented in Appendix B-2. Descriptive statistics (frequency of detection, range of positive detections, range of non-detects, location of maximum detections, and arithmetic mean) for target analytes detected in soils within the estimated area of Raymark waste at 200 Ferry Boulevard are summarized in Appendix B-1, Table 2.2.

3.2.5.2 Data Evaluation

The COPC selection process for soil is summarized in Section 2.7.2. Appendix B-1, Table 2.2 presents a summary of the COPCs for quantitative risk assessment for 200 Ferry Boulevard soils from the estimated area of Raymark waste to a depth of 10 feet bgs. No samples were collected from more than 10 feet bgs within the estimated area of Raymark waste based on property-specific field conditions. Direct exposure COPCs were identified based on a comparison of site data from the estimated area of Raymark waste to the COPC screening

levels defined in Section 2.7.2. Only eight samples from two locations at 200 Ferry Boulevard were included within the estimated area of Raymark waste. These samples were collected from depths of 0 to 10 feet bgs and only analyzed using field-screening methods. Field-screening data for metals and asbestos were used to identify COPCs. As described in Appendix B-3, field-screening data for PCBs are inadequate for quantitative risk assessment purposes.

Direct Exposure COPCs

Maximum detections in soil were compared to COPC screening levels based on EPA Region IX PRGs for industrial soils. As discussed in Section 2.7.2, EPA Region I recommends the use of EPA Region IX PRGs for COPC selection (EPA, 1994c). Region IX PRGs are risk-based screening criteria. The following chemicals were identified as direct exposure COPCs based on a comparison of maximum concentrations in soils within the estimated area of Raymark waste at this property to risk-based COPC screening levels for commercial land use, as shown in Appendix B-1, Table 2.2:

- Asbestos
- Lead

Because only lead and asbestos have been identified as COPCs for this property, no evaluation of hazard indices or cancer risks was performed. This risk assessment consists of a lead evaluation and a qualitative discussion of asbestos sample results.

Exposure Point Concentrations

Exposure point concentrations used in the lead evaluation for 200 Ferry Boulevard are presented in Appendix B-10, Table 2.

3.2.5.3 Exposure Assessment

The exposure assessment contains a discussion of the potential for human exposure at 200 Ferry Boulevard. Under current and future conditions, potential human receptors (commercial workers) are assumed to be exposed to soil only within the estimated area of Raymark waste at the property.

Land Use and Access

The property at 200 Ferry Boulevard is a commercial property, as described in Section 3.2.1.

Potential Receptors

The receptors retained for quantitative evaluation at 200 Ferry Boulevard are current and future commercial workers. Potentially exposed individuals are limited to those who work at the property.

Possible exposures of commercial workers to site-related contaminants would be through inadvertent contact during commercial/industrial activities at the property. Under the current and future land use, commercial workers were evaluated for exposure to soils (0 to 10 feet bgs) at a limited area (soils within the estimated area of Raymark waste) only. Appendix B-10, Table 2 presents the exposure assumptions for commercial workers used in the lead evaluation.

Exposure Pathways

The primary routes of exposure for potential human receptors at 200 Ferry Boulevard are incidental ingestion of and dermal contact with soil. Potential exposure to volatile emissions and fugitive dust from the property is considered to be minimal. The portion of the property shown as the estimated area of Raymark waste is entirely paved. The presence of pavement reduces the likelihood of inhalation exposures.

A qualitative evaluation of potential inhalation risks from exposure to asbestos is presented in Section 3.2.5.4. Asbestos is present in soils within the estimated area of Raymark waste at 200 Ferry Boulevard. The presence of pavement suggests that exposures to fugitive dust and volatile emissions are currently insignificant, thereby eliminating the need for quantitative evaluation of this exposure pathway.

3.2.5.4 Risk Characterization

A summary of the quantitative lead evaluation and the qualitative asbestos evaluation for 200 Ferry Boulevard is provided in this section. Results of the evaluations of lead exposures are presented in Appendix B-10.

Exposure to Lead

Lead was identified as a COPC in soils within the estimated area of Raymark waste at the property. Lead was detected in samples collected from 0 to 10 feet bgs within the estimated area of Raymark waste at a maximum concentration of 817 mg/kg. The average lead concentration in this dataset was 213 mg/kg.

Exposure to lead in soil by the commercial worker was evaluated by use of a slope-factor approach developed by the EPA Technical Review Workgroup for Lead (EPA, December 1996d), as discussed in Section 2.7.4.7. The exposure point concentration of 213 mg/kg for soil within the estimated area of Raymark waste at 200 Ferry Boulevard was used to estimate the probability that the fetal blood-lead levels of fetuses born to workers exposed to lead in a commercial setting will exceed 10 µg/dL. In order to prorate exposures, the fraction of the property estimated to contain Raymark waste (FRW) was factored into the intake equations shown in Appendix B-10. Table 1-1 presents the property sizes and FRW values for each property. The FRW for 200 Ferry Boulevard is 0.07. EPA's stated goal for lead is that individuals exposed would have no more than a 5 percent probability of exceeding the level of concern of 10 µg/dL. Under the commercial scenario for the estimated area of Raymark waste at 200 Ferry Boulevard, the range of probabilities that the fetal blood-lead concentration exceeds 10 µg/dL is 0.2 to 0.6 percent. The input parameters used and the results of lead models are presented in Appendix B-10.

Exposure to Asbestos

Asbestos was detected in all soil samples collected from the estimated area of Raymark waste at a concentration range of 2 to 25 percent. These samples were collected from the 0- to 10-foot bgs interval. The average concentration was 10 percent. Although quantitative risk estimates (inhalation risk estimates) have not been developed for this parameter, it should be

noted that asbestos-containing material is defined as material containing more than 1 percent asbestos (Appendix A to Subpart M of 40 CFR 61) (EPA, 1990). Asbestos is considered a potential inhalation hazard if it is "friable" (can be crumbled, pulverized, or reduced to powder) and, consequently, subject to entrainment/migration into the air.

The presence of pavement in the estimated area of Raymark waste reduces the potential for airborne asbestos at 200 Ferry Boulevard. Based on field conditions in the estimated area of Raymark waste at the property, it is likely that asbestos does not currently present a significant inhalation risk from the estimated area of Raymark waste at this property. If asbestos containing soils are disturbed, the potential for airborne asbestos exposure and associated inhalation risks exists.

3.2.5.5 Uncertainties

A detailed discussion of uncertainties associated with the various aspects of risk assessment, in general, was provided in Section 2.7.6. Area-specific uncertainties for 200 Ferry Boulevard are presented in the following narrative.

- Uncertainty associated with the extent of the estimated area of Raymark waste adds uncertainty in the risk assessment. The associated uncertainties propagate through the risk assessment, not only in which samples are included in the evaluation, but also in the exposure assessment, which relies on prorating of exposure intake based on the percentage of the property estimated to contain Raymark waste (FRW). Uncertainty in the identification of samples meeting the definition of Raymark waste includes accuracy and precision of analytical methods. Limitations in the determination of the areal extent of Raymark waste for each property are discussed in Section 2.3.

- The use of the FRW factor in prorating exposures assumes that individual receptors will spend time within the estimated area of Raymark waste in direct proportion to the percent of the property estimated to contain Raymark waste. The total area of the 200 Ferry Boulevard property is 0.6 acres, with an estimated 7 percent containing Raymark waste. A physical description of the estimated area of Raymark waste at the property is provided in Section 3.2.4. The waste area is near Ferry Boulevard along the edge of the property and is entirely paved. No consideration has been given to site characteristics

other than the presence of buildings. Because of the small size of the estimated area of Raymark waste, it is unlikely that individuals will spend all of their time within that area. However, if that were the case, reasonable maximum risks for exposure to the estimated area of Raymark waste would be approximately 14 times greater than those estimated using the FRW factor.

- Only two locations at 200 Ferry Boulevard were identified as meeting the definition of Raymark waste. A total of eight samples were collected from these two locations. Use of such small datasets adds uncertainty to the risk assessment.

- The samples were only analyzed using field-screening methods. Risk estimates for exposures to the estimated area of Raymark waste were limited by the extent of sample collection and analysis from locations within the estimated area of Raymark waste itself. For 200 Ferry Boulevard, sample analyses were limited to lead, copper, and asbestos. Eight samples within the estimated area of Raymark waste were analyzed for PCBs using field-screening methods. Three of these samples exceed the Region IX PRG for industrial soil. These results are inadequate for quantitative risk characterization, however they suggest the presence of PCBs at potential levels of concern. As a result of the limited sample analyses, cancer risk estimates and hazard indices cannot be calculated at this property. It is possible that PCBs and other contaminants are present and that associated exposures exist, which are not quantified in this evaluation.

- Samples collected from depths of 0 to 10 feet bgs were included in the risk assessment for current and future commercial workers. Current exposures to commercial workers are likely to involve only contact with surface soils. For this reason, inclusion of deeper soils adds uncertainty to the estimate of risks for current commercial workers. In addition, future commercial workers may be exposed to soils currently located at depths up to 15 feet bgs, which is the depth considered as accessible by CTDEP (CTDEP, 1996). The absence of samples collected in the 10- to 15-foot bgs interval adds uncertainty in the evaluation of risks to future commercial workers.

- A comparison of soils data from the property outside the estimated area of Raymark waste to CT RSRs is provided in Appendix B-10. The presence of benzo(a)pyrene and chromium at concentrations greater than CT RSRs for industrial soil suggests that risks

from other areas of the property may be of concern. Chromium is present in soils located outside the estimated area of Raymark waste at concentrations up to 208 mg/kg and benzo(a)pyrene is present at concentrations up to 1.1 mg/kg. Dioxins were detected in soils outside the estimated area of Raymark waste; however, no CT RSRs are available for dioxins. Dioxin TEQ concentrations in soils outside the estimated area of Raymark waste exceed EPA Region IX PRGs for industrial soil in two samples.

Six samples from outside the estimated area of Raymark waste were analyzed for PCBs using CLP methods. While none of these samples had concentrations greater than the CT RSRs for industrial soil, two samples did have total Aroclor concentrations greater than the EPA Region IX PRG for industrial soil. Individual Aroclors detected include Aroclors 1254, 1262, and 1268. Lead was detected at concentrations up to 395 mg/kg. Copper was detected at concentrations up to 997 mg/kg. Asbestos is also present outside the estimated area of Raymark waste at 200 Ferry Boulevard at concentrations up to 8 percent. Thus, a commercial worker's exposure and risk from the entire property are likely to be greater than that estimated for the area of Raymark waste alone.

3.2.5.6 Summary of Human Health Risk Assessment

This section presents a summary of major risk assessment findings for soils estimated to contain Raymark waste at 200 Ferry Boulevard. Risks to commercial workers were estimated.

- Only lead and asbestos have been identified as COPCs in soils within the estimated area of Raymark waste, therefore no evaluation of hazard indices or cancer risks was performed.

- Exposure to lead in soil by commercial workers was evaluated by use of a slope-factor approach developed by the EPA Technical Review Workgroup for Lead (EPA, December 1996d). The results of the slope-factor approach indicate that adverse effects are not anticipated for fetuses of pregnant workers exposed to lead in soil within the estimated area of Raymark waste.

- Asbestos was detected in all soil samples collected from the estimated area of Raymark waste at 200 Ferry Boulevard in the 0- to 10-foot bgs interval at a concentration range of 2 to 25 percent. The average concentration was 10 percent.

3.2.6 Ecological Evaluation

No ecologically significant habitats are present on this property. The ecological characterization of the wetlands in the vicinity of this property was addressed under the OU3 Area I RI (TtNUS, 1999b) and is presented in the *Draft Technical Memorandum Wetland Evaluation, Raymark-Ferry Creek-OU3* (B&RE, 1998). A summary of the findings is presented below. It should be noted, however, that no individual evaluation of the ecological impacts on this property was performed.

Most of the property has been disturbed by surrounding development, past uses of Ferry Creek, and filling of a wetland area prior to developing the property. There are no wetlands on the property, but the parcel abuts Ferry Creek. There is limited vegetation on the parcel as most of the property is covered by a building or pavement (see Figure 3-2).

This property provides only limited use as an area for birds, reptiles, and small mammals to forage, cover, rest and breed because of the level of development, soil contamination, disturbed nature of the area, and the low vegetation density and diversity. Wildlife identified in the area include red-winged blackbird (*Agelaius phoeniceus*) and green heron (*Butorides striatus*).

3.2.7 Summary

This 0.6-acre property abutting Ferry Creek contains Raymark waste. Soil samples containing metals, pesticides, and SVOCs that exceed CT DEC and/or CT PMC criteria and asbestos greater than 1 percent were collected on the property. Dioxins were also detected. Since most of the property is covered by buildings or pavement, only limited infiltration or leaching is likely occurring in the areas of cracked pavement and vegetation. Some erosion along the bank of the property into Ferry Creek is likely occurring.

No evaluation of hazard indices or cancer risks was performed, as lead and asbestos were the only COPCs identified. Adverse effects are not anticipated for fetuses of pregnant workers

exposed to lead in the soils within the estimated area of Raymark waste. The average asbestos concentration in the estimated area of Raymark waste was 10 percent. Quantitative estimates of risks from PCB exposure were not calculated due to a lack of CLP data within the estimated area of Raymark waste; however, screening samples suggest the presence of PCBs at potential levels of concern.

No ecologically significant habitats were identified on the property.

TABLE 3-2
200 FERRY BOULEVARD - SOIL ANALYTICAL RESULTS **
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
REMEDIAL INVESTIGATION
RAYMARK - OU6
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Average Detected Conc.	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Industrial) (1) (2)	Number of Exceedances of CT DEC (1) (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)
Asbestos (%)										
Asbestos	47	77	2	4	Trace	25	1	32		
Dioxin (UG/KG)										
1,2,3,4,6,7,8-HpCDD	1	5	0.25	0.32	0.319	0.319				
1,2,3,4,6,7,8-HpCDF	3	5	0.33	0.33	0.111	0.44 J				
1,2,3,4,7,8,9-HpCDF	1	5	0.15	0.0054	0.0054	0.0054				
1,2,3,4,7,8-HxCDD	1	5	0.2	0.0026	0.0026	0.0026				
1,2,3,4,7,8-HxCDF	1	5	0.1	0.014	0.0135	0.0135				
1,2,3,6,7,8-HxCDD	1	5	0.15	0.0086	0.0086	0.0086				
1,2,3,6,7,8-HxCDF	1	5	0.14	0.0088	0.0088	0.0088				
1,2,3,7,8,9-HxCDD	1	5	0.25	0.0065	0.0065	0.0065				
1,2,3,7,8,9-HxCDF	1	5	0.056	0.0016	0.0016	0.0016				
1,2,3,7,8-PeCDD	1	5	0.13	0.0018	0.0018	0.0018				
1,2,3,7,8-PeCDF	1	5	0.089	0.0019	0.0019	0.0019				
2,3,4,6,7,8-HxCDF	1	5	0.093	0.014	0.0136	0.0136				
2,3,4,7,8-PeCDF	1	5	0.12	0.0055	0.0055	0.0055				
2,3,7,8-TCDF	1	5	0.071	0.0098	0.0098	0.0098				
OCDD	4	5	3	3.5	3.31 J	3.95				
OCDF	4	5	1.9	2.3	0.274	3.21 J				
Total HpCDD	1	5	0.3	0.59	0.586	0.586				
Total HpCDF	3	5	0.62	0.93	0.251	1.27 J				
Total HxCDD	1	5	0.1	0.06	0.0595	0.0595				
Total HxCDF	1	5	0.081	0.2	0.197	0.197				
Total PeCDD	1	5	0.13	0.011	0.0105	0.0105				
Total PeCDF	1	5	0.1	0.15	0.153	0.153				
Total TCDD	1	5	0.1	0.0073	0.0073	0.0073				
Total TCDF	1	5	0.087	0.089	0.0888	0.0888				
Toxicity Equivalency	4	5	0.28	0.27	0.011 J	0.665813				

TABLE 3-2 (cont.)
200 FERRY BOULEVARD - SOIL ANALYTICAL RESULTS **
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
REMEDIAL INVESTIGATION
RAYMARK - OU6
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Average Detected Conc.	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Industrial) (1) (2)	Number of Exceedances of CT DEC (1) (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)
Metals (MG/KG)										
Aluminum	7	7	9030	9030	5410 J	14800				
Arsenic	7	7	5.1	5.1	2.4	6.6	10	0		
Barium	6	7	76.6	85.4	58.2 J	119 J	140000	0		
Beryllium	6	6	0.41	0.41	0.1	0.69 J	2	0		
Cadmium	6	7	1.6	1.8	0.58	4.8	1000	0		
Calcium	7	7	12300	12300	1800	54600				
Chromium	7	7	107	107	23.2	208 J	100	3		
Cobalt	7	7	7.8	7.8	5.7	9.9	2500	0		
Copper	29	44	235	295	33.8 J	1100	76000	0		
Iron	7	7	17500	17500	13400	21400 J				
Lead	45	77	109	166	40.1	817	1000	0		
Magnesium	7	7	5520	5520	2330 J	10700				
Manganese	7	7	202	202	149	244	47000	0		
Mercury	6	7	0.83	0.95	0.17	1.8 J	610	0		
Nickel	7	7	32.5	32.5	16.3	53.7	7500	0		
Potassium	7	7	1710	1710	804 J	3040				
Selenium	1	7	0.48	1.1	1.1	1.1	10000	0		
Silver	1	7	0.29	0.4	0.4	0.4	10000	0		
Sodium	2	6	416	945	640	1250				
Vanadium	7	7	29	29	19.9	45.7 J	14000	0		
Zinc	7	7	377	377	95.3 J	673 J	610000	0		
Metals (SPLP) (UG/L)										
Aluminum	1	1	1800	1800	1800	1800				
Barium	1	1	183	183	183	183			10000	0
Cadmium	1	1	0.81	0.81	0.81	0.81			50	0
Calcium	1	1	7820	7820	7820	7820				
Chromium	1	1	6.1	6.1	6.1	6.1			500	0
Copper	1	1	53.6	53.6	53.6	53.6			13000	0
Iron	1	1	2170	2170	2170	2170				

TABLE 3-2 (cont.)
200 FERRY BOULEVARD - SOIL ANALYTICAL RESULTS **
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
REMEDIAL INVESTIGATION
RAYMARK - OU6
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Average Detected Conc.	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Industrial) (1) (2)	Number of Exceedances of CT DEC (1) (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)
Metals (SPLP) (UG/L) (cont.)										
Lead	1	1	42.2	42.2	42.2	42.2			150	0
Magnesium	1	1	967	967	967	967				
Manganese	1	1	40.4	40.4	40.4	40.4				
Vanadium	1	1	10.2	10.2	10.2	10.2			500	0
Zinc	1	1	168	168	168	168			50000	0
Metals (TCLP) (UG/L)										
Cadmium	1	1	5.3	5.3	5.3	5.3			50	0
Lead	1	1	80.2	80.2	80.2	80.2			150	0
Mercury	1	1	2.2	2.2	2.2	2.2			20	0
Semivolatile Organic Compounds (UG/KG)										
2-Methylnaphthalene	3	5	140	64	64 , J	64 , J	2500000	0	9800	0
4-Chloro-3-methylphenol	2	5	220	64	64 J	64 J				
Acenaphthene	3	5	150	73	55 J	110	2500000	0	84000	0
Acenaphthylene	4	5	200	170	120	190 J	2500000	0	84000	0
Anthracene	4	5	270	260	210	300	2500000	0	400000	0
Benzo(a)anthracene	4	5	1200	1500	990	1800	7800	0	1000	3
Benzo(a)pyrene	4	5	910	1100	950	1100	1000	3	1000	3
Benzo(b)fluoranthene	4	5	1300	1600	1100	1800	7800	0	1000	4
Benzo(g,h,i)perylene	4	5	600	660	650	680 J	2500000	0	42000	0
Benzo(k)fluoranthene	1	5	530	970	970	970	78000	0	1000	0
bis(2-Ethylhexyl)phthalate	1	5	390	260	260	260	410000	0	11000	0
Butylbenzylphthalate	2	5	300	130	59	205	2500000	0	200000	0
Carbazole	4	5	110	61	52 J	76	290000	0	360	0
Chrysene	4	5	1200	1500	1200	1700	780000	0	1000	4
Dibenzo(a,h)anthracene	1	5	380	220	220	220	780	0	1000	0
Dibenzofuran	3	5	140	53	52 J	56	2500000	0	5600	0
Di-n-Butylphthalate	1	5	350	82	82	82	2500000	0	140000	0
Fluoranthene	4	5	1700	2000	1800	2300	2500000	0	56000	0
Fluorene	3	5	190	140	100 J	205	2500000	0	56000	0

TABLE 3-2 (cont.)
200 FERRY BOULEVARD - SOIL ANALYTICAL RESULTS **
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
REMEDIAL INVESTIGATION
RAYMARK - OU6
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Average Detected Conc.	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Industrial) (1) (2)	Number of Exceedances of CT DEC (1) (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)
Semivolatile Organic Compounds (UG/KG) (cont.)										
Indeno(1,2,3-cd)pyrene	3	5	490	560	540 J	590	7800	0	1000	0
Naphthalene	3	5	140	62	55 J	77	2500000	0	56000	0
N-Nitroso-diphenylamine	3	5	400	480	410	520 J	1200000	0	1400	0
Phenanthrene	4	5	780	890	850 J	1000	2500000	0	40000	0
Phenol	1	5	320	33	33 J	33 J	2500000	0	800000	0
Pyrene	4	5	1700	2000	1500	2500	2500000	0	40000	0
Total PAH	2	2	12000	12000	11602	13256				
Volatile Organic Compounds (UG/KG)										
2-Butanone	1	5	8	7	7	7	1000000	0	80000	0
2-Hexanone	1	5	8	14	14	14	1000000	0	56000	0
4-Methyl-2-Pentanone	4	5	3	3	2 J	6	1000000	0	14000	0
Acetone	1	5	41	60	60	60	1000000	0	140000	0
Bromoform	1	5	7	4	4	4	720000	0	800	0
Carbon Disulfide	3	5	5	3	3 , J	3 , J	1000000	0	140000	0
Ethylbenzene	2	5	6	4	2	7	1000000	0	10100	0
Toluene	1	5	7	6	6	6	1000000	0	67000	0
Total Xylenes	3	5	15	21	7 J	43	1000000	0	19500	0
Trichloroethene	1	5	6	2	2	2	520000	0	1000	0
Pesticide/PCB (UG/KG)										
4,4'-DDD	4	6	8.6	8	1.7 J	11 J	24000	0	29	0
4,4'-DDE	6	6	4.4	4.4	0.74 J	11	17000	0	21	0
4,4'-DDT	4	6	18	20	3.9 J	30	17000	0	21	3
alpha-Chlordane	5	6	2.1	2.3	0.99 J	4.7 J	2200	0	66	0
Aroclor, Total (4)	12	73	310	1000	136	3400	10000	0		
Aroclor, Total (Conservative)(5)	12	73	400	1600	316	4150	10000	0		
Aroclor-1254	1	73	160	130	130	130	10000	0		
Aroclor-1262	5	66	180	190	58 J	480 J	10000	0		
Aroclor-1268	11	73	290	990	65 J	3400	10000	0		

TABLE 3-2 (cont.)
200 FERRY BOULEVARD - SOIL ANALYTICAL RESULTS **
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
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RAYMARK - OU6
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Average Detected Conc.	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Industrial) (1) (2)	Number of Exceedances of CT DEC (1) (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)
Pesticide/PCB (UG/KG) (cont.)										
beta-BHC	3	6	6.4	7.2	2.5	9.5 J	3200	0	3.9	2
Dieldrin	2	5	3.4	2.7	0.82 J	4.6	360	0	7	0
Endosulfan I	1	6	3.1	2.3	2.3	2.3	1200000	0	8400	0
Endosulfan II	1	6	7.4	17	17 J	17 J	1200000	0	8400	0
Endosulfan Sulfate	2	6	7.5	7.5	4	11	1200000	0	8400	0
Endrin Aldehyde	3	6	5.4	3.3	1.8 J	6.4	610000	0		
Endrin Ketone	2	6	7.9	11	10 J	12	610000	0		
gamma-Chlordane	4	5	2.7	3	1.2 J	6.5	2200	0	66	0
Heptachlor Epoxide	1	6	4.2	8.6	8.6	8.6	630	0	20	0
Methoxychlor	2	6	26	17	6.1 J	27 J	10000000	0	8000	0

Qualifier	Definition
J	Quantitation approximate

Notes:

** Analytical results in this table are from samples collected throughout the property, not just the estimated area of Raymark Waste.

(1) Asbestos is included with a criterion of 1% in the CT DEC column for comparison purposes. It's criterion is not a promulagated CT Remediation Standard Regulation.

(2) CT DEC - Direct Exposure Criteria for Residential or Commercial/Industrial Soils. CT Remediation Standard Regulations, January 1996, and additional approved criteria.

(3) CT PMC - Pollutant Mobility Criteria for soils in a GB aquifer area. CT Remediation Standard Regulations, January 1996, and additional approved criteria.

(4) Aroclor, Total is the sum of the results of all detected individual Aroclors.

(5) Aroclor, Total (Conservative) is the sum of the results of all detected individual Aroclors and one half the detection limit of non detected individual Aroclors.

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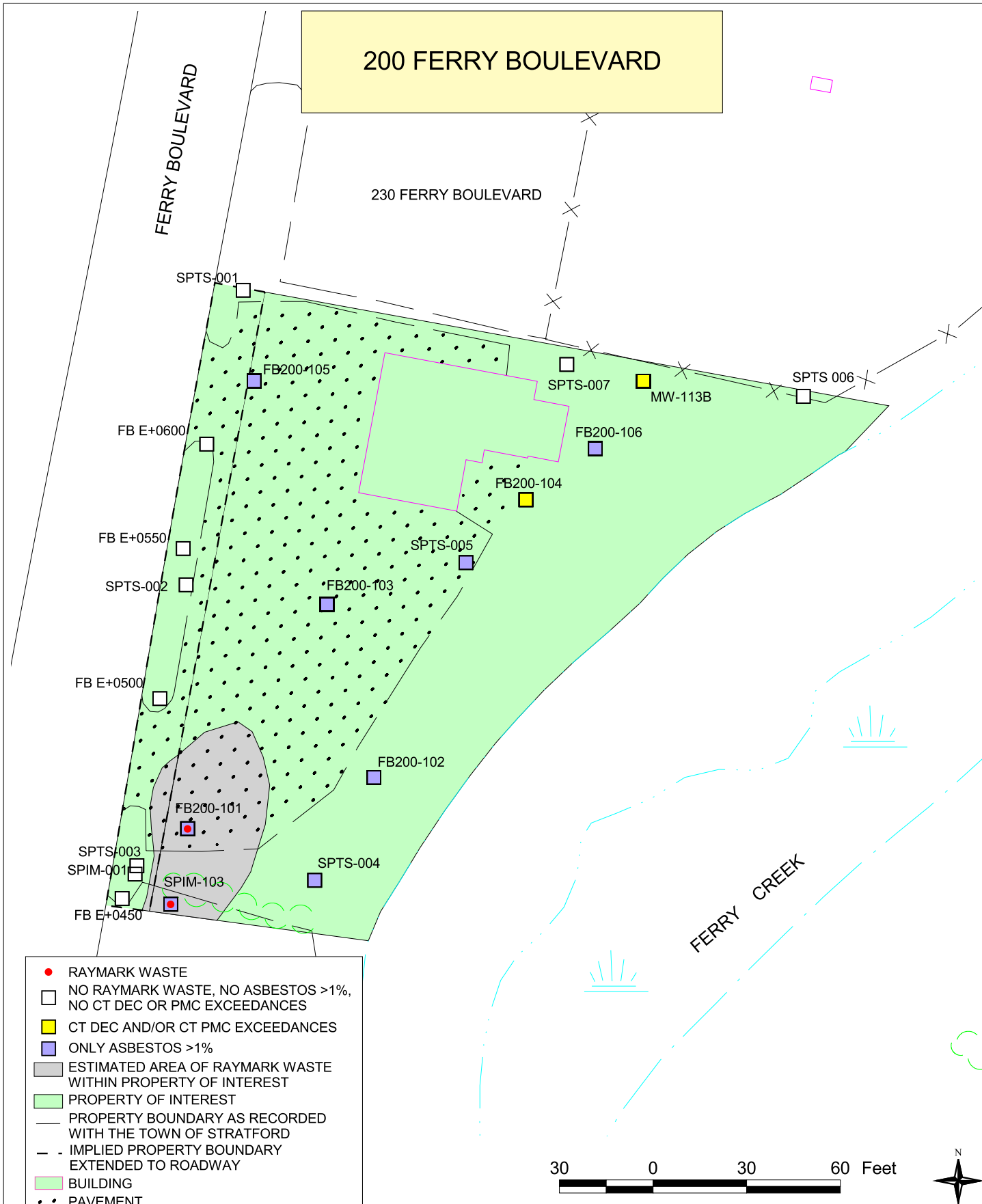

NOTES:
1) PLAN NOT TO BE USED FOR DESIGN
2) ALL LOCATIONS TO BE CONSIDERED APPROXIMATE
3) PROPERTY BOUNDARIES ARE APPROXIMATE BASED ON TOWN OF STRATFORD ENGINEERING DEPARTMENT PLANS
4) DUE TO UNCERTAINTIES OF PROPERTY BOUNDARIES DURING THE SAMPLING PROCESS, SAMPLES LOCATED ADJACENT TO THE PROPERTY ARE UNDERSTOOD TO BE ON THE PROPERTY
5) CT DIRECT EXPOSURE CRITERIA (CT DEC) FOR INDUSTRIAL/COMMERCIAL SOILS AND CT POLLUTANT MOBILITY CRITERIA (CT PMC) USED TO DETERMINE EXCEEDANCES.

SOIL SAMPLE LOCATIONS	FIGURE 3-2
RAYMARK - OU6	
STRATFORD, CONNECTICUT	
DRAWN BY: L. SEYDEWITZ	DATE: APRIL 27, 2004
CHECKED BY: D. CHISHOLM	FILE: C\...\OU6_RI_2003.APR

TETRA TECH NUS, INC.
55 JONSPIN ROAD WILMINGTON, MA 01887
(978)658-7899

3.3 230 Ferry Boulevard

This property is one of the 24 properties evaluated in this report (see Figure 1-2). Raymark waste has been found in fill materials on this property. See Section 3.3.3 for a table detailing the soil sample locations determined to contain Raymark waste at this property.

3.3.1 Property Description

This property, approximately 2.5 acres of commercially-zoned (retail) land, is located on Ferry Boulevard in Stratford, Connecticut (Town of Stratford, 1997). The property is currently occupied by a used car dealership. A one-story building, located in the center of the property, is surrounded by deteriorated asphalt pavement for parking. The vast majority of the lot is paved and covered with cars. Numerous cracks and repairs to the asphalt are evident throughout the property, but the asphalt pavement is most deteriorated at the rear of the building, where differential settling has occurred. Previous site observations noted that a fuel storage tank (estimated at 500 gallons) was once located on the asphalt behind the building, however, due to the high volume of vehicles on the lot, the current status of the tank could not be verified. An old fuel pump is also present in the rear parking lot.

A narrow strip of dense shrub and tree vegetation is present along Ferry Creek, outside the eastern fence line. A narrow strip of grass is also present along Ferry Boulevard. The topography of the property is relatively flat with a gentle slope towards Ferry Creek. A seep was identified on the eastern bank of the property in Ferry Creek. Elevated levels (above background) of trichloroethene (TCE) have been detected in surface water samples collected from the seep.

A swale is located along the northern edge of the property. Ferry Creek is located on the eastern edge of the property, 200 Ferry Boulevard (see Section 3.2) is to the south, Ferry Boulevard is to the west, and 250 Ferry Boulevard (see Section 3.4) is to the north, abutting the swale.

A stormwater drain was observed in the front parking lot near Ferry Boulevard. The paved parking lot in the northeast corner of the property is flooded by Ferry Creek during extreme high tide events. Soils at the property, including the swale, are classified as fill material that has

been placed in wetlands (tidal marshes). Brake pads were observed at the surface on the banks of the swale.

The swale is located along the northern border of the property. Town records show that the swale is the result of a DOT drainage easement that has been on the property since 1938. The swale is tidally influenced by water from Ferry Creek and carries surface water drainage from Ferry Boulevard and the surrounding properties to Ferry Creek. The culvert pipe under Ferry Boulevard that leads to the swale has partially collapsed. The steep banks of the swale slope down about 3 feet. Water flow in the swale is restricted due to the dense reeds (*Phragmites australis*) and other debris. Access to the swale is limited from the north and south by a chain-link fence. Public access at the western end of the swale along Ferry Boulevard and the eastern end at Ferry Creek is not restricted. A trail was cleared by unknown entities in July 2002 along the edge of the swale against the fence line, providing clear access to Ferry Creek. Typically, however, this stretch of the property is not cleared and is covered with dense reeds and other vegetation.

A chain-link fence (estimated 6 feet high) restricts access to the side and rear parking lots of the property. The front parking lot has unrestricted public access through the two driveways in front of the building. There is a small, white wooden fence (estimated 2 feet high) running between the front parking lot and Ferry Boulevard. The fence is open at the two driveways. During non-business hours, cars are usually parked in the openings of the fence restricting vehicular access to the property; however, foot traffic is not restricted.

3.3.2 Physical Characteristics

According to FEMA Flood Insurance Rate Maps for Stratford, Connecticut, portions of the property at 230 Ferry Boulevard are located within the 100-year floodplain of the Housatonic River. The 100-year frequency base flood elevation for the property is 10 feet (FEMA, 1992). See Figure 1-2 for the boundary of the floodplain on this property.

Twelve soil borings (A2-SB02, A2-SB04, A2-SB04A, SPVM-101 through 106, and FBSWL-101 through 103) were advanced on the property to depths of up to 16 feet below ground surface (bgs). Surficial materials in the borings consist of fill overlying peat, silt, or organic silt with varying amounts of clay. The organic materials are characteristic of a former marsh and swamp

deposit. Fuel odors were noted in the soil cuttings from borings A2-SB02 and SPVM-104. Drilling at boring SPVM-104 was terminated before the bottom of fill was encountered because an oily substance was observed. No organic layer was identified prior to terminating the boring. Refer to Figure 3-3 for boring locations on the property. Boring logs are presented in Appendix A. No monitoring wells have been installed on the property.

Three of twelve borings (FBSWL-101, FBSWL-102, and FBSWL-103), each approximately 6 feet in depth, were advanced in the drainage swale. Based on the boring logs, surficial materials primarily consist of fill overlying silt with plant fibers and fine sand, peat, and/or organic silt with trace amounts of sand. The organic materials are characteristic of a former marsh and swamp deposit. Raymark wastes were reportedly disposed of as fill in this area. Brake pads and asbestos were observed at the surface on the banks of the swale. Manmade materials identified in the soil borings included potentially asbestos-containing material (PACM) and plastic sheeting. These materials were encountered with natural fill materials consisting of silt-sand and sand-silt mixtures. Manmade debris was also observed in the organic silt layer encountered in soil boring FBSWL-101.

Soil sample locations are shown on Figure 3-3, including shallow surface samples and deeper samples from soil borings. The borings were used to describe the fill and native material on the property. All sampling locations were used to determine the presence or absence of Raymark waste and identify those locations that exceed the Connecticut RSRs.

Fill on this property consists of both natural and manmade materials that were placed on the property as a result of human activity. Manmade materials, including brake pads, PACM, brick, asphalt shingles, copper wire, cloth, glass, nails, gasket materials, metal, plastic, rubber, a tar-like substance, tiles, and/or wood were identified in the soil borings. PACM was identified in the majority of the borings on this property. These materials were encountered with natural fill materials consisting of sand, silt, and gravel mixtures. Manmade debris was also identified in the peat, silt, and/or organic silt layers encountered in soil borings A2-SB02, A2-SB04, A2-SB04A, and SPVM-103. Fill classifications were based on the visual characteristics of the soil and sediment samples that were collected during the field investigations. The depth to groundwater ranges from 3 feet to 7 feet bgs, based on the soil moisture content recorded on the boring logs. Based on interpretations and field observations, fill was identified in borings across the entire property.

Raymark waste was found in fill materials on this property. The limits of the area of Raymark waste have been estimated by the presence of asbestos, lead, copper and/or Aroclor 1268 meeting the definition of Raymark waste, as defined in Section 2.2 of this report. These limits are shown on Figure 3-3. Approximately 27.4 percent of this property was estimated to contain Raymark waste. The vast majority of the estimated area of Raymark waste is paved. Only those samples collected in the swale and outside the fence were from uncovered areas.

3.3.3 Nature and Extent of Contamination

Contaminant concentrations in all soil samples collected at this property were compared to the Connecticut RSRs (CT DEP, 1996) to determine the potential impact of the contaminants on soils and groundwater and to provide an understanding of relative contaminant concentrations throughout the property. Results of samples from all depths, including those collected from below the water table, were compared to the direct exposure criteria for commercial/industrial soils (CT DEC) and to the pollutant mobility criteria (CT PMC) for GB areas. CT DECs are regulatory criteria for soil based predominantly on risk from exposures via the ingestion pathway with consideration given to background concentrations, detection limits, and ceiling limits. Comparison of individual property contaminant data to CT DEC serves to evaluate the potential for contaminants in soils to present a risk to human health. CT PMCs are regulatory criteria for soil based on ambient water quality criteria and modeling the migration of contaminants from soil to groundwater. A comparison of individual property contaminant data to CT PMC serves to evaluate the potential for contaminants in soils to impact groundwater quality.

There were 65 samples collected from 28 locations on this property. Sample locations with exceedances of the CT DEC and CT PMC are indicated on Figure 3-3. Samples were analyzed for asbestos, dioxins, metals, SPLP metals, pesticides, PCBs, SVOCs, and VOCs. See Table 3-3 for the number of samples analyzed for each contaminant.

A summary of the nature and extent of soil contamination is discussed below by contaminant group. The evaluation focuses on contaminants whose concentrations exceed the CT DEC and/or CT PMC. A complete set of soil analytical results for each property is provided in Appendix C. See Table 3-3 for the summary statistics and comparison to criteria. The discussion below includes all samples collected on the property, not just those determined to be within the estimated area of Raymark waste.

Asbestos

Sixty-three soil samples were collected from the property and analyzed for asbestos. Asbestos was detected frequently on the property. Asbestos was detected in 51 of the 63 samples. Asbestos at greater than 1 percent was detected in 40 of 63 samples. Detections were scattered throughout the property at depths ranging from surface to 14 feet bgs. The maximum amount of asbestos observed at the property was 90 percent.

Dioxins

Six soil samples were collected from the property and analyzed for dioxins. Dioxin concentrations are expressed as Toxicity Equivalents (TEQ) values. See Section 2.5.2.5 for an explanation of TEQ. TEQ values ranged from 0.0139 µg/kg to 20.14 µg/kg.

Metals

Soil samples were collected from the property and analyzed for metals as follows: 14 at a fixed laboratory; 36 samples were screened for copper; and 49 samples were screened for lead. Metals were detected very frequently on the property. Some metals are components of essential nutrients, occur naturally, or are present at such low concentrations that they are considered not of concern. These metals include aluminum, calcium, iron, magnesium, potassium, and sodium. There were two metals that exceeded the CT DEC regulatory standards. Chromium had exceedances in 6 samples and lead had exceedances in 12 samples. Exceedances occurred in samples collected from depths ranging from ground surface to 6 feet bgs. Metal exceedances were primarily located in the northern portion of the property, with most exceedances in the shallow intervals, especially in the swale area.

SPLP and TCLP Metals

Based on the data provided in Appendix C for this property, only three out of the five SPLP samples were within the estimated area of Raymark waste. Lead and chromium exceeded the CT PMC standards. No TCLP samples were collected.

Pesticides

Fourteen soil samples were collected from the property and analyzed for pesticides. Pesticides were detected fairly frequently on the property. There were no CT DEC exceedances for pesticides. There were pesticide exceedances of the CT PMC regulatory standards for 4,4'-DDE, gamma-chlordane and dieldrin. Pesticide exceedances were scattered throughout the central and northeastern portion of the property at depths up to 16 feet bgs.

PCBs

Fifty-one soil samples were collected from the property and analyzed for PCBs as Aroclors. Aroclors were detected frequently on the property, with Aroclors 1262 and 1268 both detected in over half of the samples analyzed. Nine samples exceeded the total Aroclor CT DEC standard, with Aroclor 1268 concentrations the primary contributor to the total Aroclor concentration at six of these locations. The PCB exceedances were mostly located in the northern portion of the property in samples collected from the swale at depths of up to 6 feet bgs. No SPLP/TCLP samples for PCBs were collected.

SVOCs

Thirteen soil samples were collected from the property and analyzed for SVOCs. SVOCs were detected frequently on the property. Eight SVOCs exceeded the CT DEC and/or CT PMC regulatory standards. SVOC exceedances, primarily PAHs, were located in the northeastern portion of the property at depths ranging from ground surface to 6 feet bgs.

VOCs

Eight soil samples were collected from the property and analyzed for VOCs. VOCs were sporadically detected on the property. There were no CT DEC exceedances for VOCs. Benzene was the only VOC that exceeded the CT PMC regulatory standards. The exceedance was located in boring A2-SB02 in the central portion of the property, at a depth of 4 to 6 feet bgs.

Raymark Waste

The results from nine soil sample locations indicate that Raymark waste is present on the property. The following table displays the locations and constituents of the 15 samples from those nine locations with contaminant concentrations that meet the definition of Raymark waste. These samples are located within the 27.4 percent of the property shown on Figure 3-3 as the "Estimated Area of Raymark Waste within Property of Interest".

Sample Location	Depth Interval (ft bgs)	Asbestos (%)	Lead (mg/kg)	Copper (mg/kg)	Aroclor 1268 (µg/kg)
A2-SB04A	8 to 10	40	720	780	NA
A2-SS04	2 to 4	5	757	910	2,100
SPVM-101	0 to 2	50	6,140	10,900	16,000
	2 to 4	15	7,340	12,700	19,000
SPVM-102	0 to 2	8	440	480	3,300
FBSWL-101	0 to 2	50	18,200	22,500	67,000
	2 to 4	60	17,300	18,400	74,000
	4 to 6	2	2,750	3,870	32,000
FBSWL-102	0 to 2	55	34,000	30,000	230,000
	2 to 4	50	14,900	26,800	71,000
	4 to 6	2	1,750	2,900	22,000
FBSWL-103	0 to 2	3	1,420	1,360	4,800
	2 to 4	4	1,100	1,730	4,300
SPD-10	0 to 0.5	90	36,300	40,100	160,000
SPD-5	0 to 0.5	90	10,000	NA	10,000

NA- Contaminant was not analyzed

3.3.4 Fate and Transport

Section 2.6 discusses the general approach to contaminant fate and transport and the mechanisms governing fate and transport of contaminants from areas of Raymark waste. The primary pathways for migration of contaminants throughout this property are discussed below.

Approximately 27.4 percent of the 2.5-acre parcel is estimated to contain Raymark waste. The waste area is located in the northeastern portion of the property (see Figure 3-3). Over 90 percent of the total property is covered either by a building or pavement. The vast majority of the area estimated to contain Raymark waste is within this paved area. A small portion of the waste area is not covered with pavement. The swale along the northern edge, and the eastern

edge of the property abutting Ferry Creek are vegetated, mostly with grasses which limit erosion of surface soils by wind. The swale is a man-made wetland with dense debris, roots, and reeds that constrict the flow of water, but is a vehicle for transporting sediments/contaminants into Ferry Creek. Slow-moving water likely infiltrates and leaches into the groundwater. Erosion has been observed along the banks of Ferry Creek and the swale. A stormwater drain was visible on the property; its discharge point is unknown.

SPLP data indicate that metals, specifically lead and chromium, could potentially be leaching into groundwater. Other data indicate that pesticides, SVOCs, and VOCs may also be leaching into surface water and groundwater.

3.3.5 Baseline Human Health Risk Assessment

This section contains the baseline human health risk assessment (HHRA) performed for the portion of the parcel located at 230 Ferry Boulevard that was found to contain Raymark waste in soil. Data collected from this parcel, but beyond the estimated area of Raymark waste, while useful in the delineation of Raymark waste, were not included in this risk evaluation. Soil exposures and the resulting risk estimates have thus been prorated based on the percentage of the property estimated to contain Raymark waste (FRW shown in Table 1-1). Risk estimates for exposures to the estimated area of Raymark waste are limited by the extent of sample collection and analysis from the location within the estimated area of Raymark waste itself. The use of the FRW in calculations of risk assumes that receptors use all areas of the property on an equal basis. Total risks associated with the exposure to the entire parcel at 230 Ferry Boulevard may be higher than presented in this HHRA if contaminants beyond the estimated area of Raymark waste are present or if receptors spend a higher percentage of their time within the estimated area of Raymark waste than that assumed in Table 1-1. A more detailed discussion of the HHRA approach is presented in Section 2.7. Section 3.3.5.1 provides an overview of the 230 Ferry Boulevard property, Section 3.3.5.2 presents COPCs and EPCs, Section 3.3.5.3 contains information on the potential receptors considered and the routes by which they might be exposed, Section 3.3.5.4 contains the numerical results of the risk assessment, and Section 3.3.5.5 presents property-specific uncertainties. Section 3.3.5.6 presents a property-specific summary of the major risk findings.

3.3.5.1 Overview

230 Ferry Boulevard is a commercial property of approximately 2.5 acres. A detailed description of 230 Boulevard is provided in Section 3.3.1. The nature and extent of the contamination detected at 230 Ferry Boulevard is discussed in Section 3.3.3. The area of the property estimated to contain Raymark waste represents an estimated 27 percent of the total 2.5-acre property, exclusive of any buildings, and is shown in Figure 3-3. Property-specific site conditions within the estimated area of Raymark waste are described in Section 3.3.2. Listings of samples included in the risk evaluation are presented in Appendix B-2. Descriptive statistics (frequency of detection, range of positive detections, range of non-detects, location of maximum detections, and arithmetic mean) for target analytes detected in soils within the estimated area of Raymark waste at 230 Ferry Boulevard are summarized in Appendix B-1, Table 2.3.

3.3.5.2 Data Evaluation

The COPC selection process for soil is summarized in Section 2.7.2. Appendix B-1, Table 2.3 presents a summary of the COPCs for quantitative risk assessment for 230 Ferry Boulevard soils from the estimated area of Raymark waste to a depth of 15 feet bgs. Direct exposure COPCs were identified based on a comparison of site data from the estimated area of Raymark waste to the COPC screening levels defined in Section 2.7.2. All validated CLP data were used to identify COPCs. Screening data were also used for metals.

Direct Exposure COPCs

Maximum detections in soil were compared to COPC screening levels based on EPA Region IX PRGs for industrial soils. As discussed in Section 2.7.2, EPA Region I recommends the use of EPA Region IX PRGs for COPC selection (EPA, 1994c). EPA Region IX PRGs are risk-based screening criteria. The following chemicals were identified as direct exposure COPCs based on a comparison of maximum concentrations in soils within the estimated area of Raymark waste at this property to risk-based COPC screening levels for commercial land use, as shown in Appendix B-1, Table 2.3:

- Asbestos
- Acetophenone

- PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h) anthracene, and indeno(1,2,3-cd)pyrene)
- Aroclors, Total (1248, 1262 and 1268)
- Metals (arsenic, barium, chromium, and lead)
- Dioxins

Exposure Point Concentrations

The methods used to identify appropriate exposure point concentrations are described in Section 2.7.2. Exposure point concentrations used in the risk assessment for 230 Ferry Boulevard are presented in Appendix B-1, Table 3.3. Support documentation for the calculation of dioxin TEQ concentrations is presented in Appendix B-4. Support documentation for the calculation of 95 percent UCLs for COPCs is presented in Appendix B-5.

3.3.5.3 Exposure Assessment

The exposure assessment contains a discussion of the potential for human exposure at 230 Ferry Boulevard and identifies the rationale for the selection of exposure input parameters used to estimate exposure intakes. A detailed description of the potential receptors, exposure routes, and intake estimation methods used in the exposure assessment is presented in Section 2.7.3. Area-specific information regarding exposure is provided in this section.

Under current and future conditions, potential human receptors (commercial workers) are assumed to be exposed to soil only within the estimated area of Raymark waste at the property under reasonable maximum exposure (RME) conditions.

Land Use and Access

The property at 230 Ferry Boulevard is a commercial property, as described in Section 3.3.1.

Potential Receptors

The receptors retained for quantitative evaluation are current and future commercial workers. Potentially exposed individuals are limited to those who work at 230 Ferry Boulevard.

Possible exposures of commercial workers to site-related contaminants would be through inadvertent contact during commercial/industrial activities at the property. Under the current and future land use, commercial workers were evaluated for exposure to soils (0 to 15 feet bgs) at a limited area (soils within the estimated area of Raymark waste) only. Appendix B-1, Table 4.1 presents the exposure assumptions for commercial workers at this and other commercial properties in the RI.

Exposure Pathways

The primary routes of exposure for potential human receptors at 230 Ferry Boulevard are incidental ingestion of, and dermal contact with, soil. Potential exposure to volatile emissions and fugitive dust from the property is considered to be minimal. Qualitative evaluations of the inhalation pathway are provided below. The estimated area of Raymark waste is mostly paved with uncovered portions vegetated with grasses and phragmites. The presence of pavement and vegetation reduces the likelihood of inhalation exposures.

A qualitative comparison of maximum detected soil concentrations and EPA Generic SSLs for inhalation, based on inter-media transfer from soil to air (EPA, 1996a), was performed to determine if additional quantitative analysis of this potential exposure pathway was warranted. The inhalation SSLs are based on residential land use and lifetime exposure scenarios and are therefore relatively conservative values for potential receptors at commercial properties. Appendix B-1, Table 2.3 presents available inhalation SSLs for contaminants in soils within the estimated area of Raymark waste at the property. With the exception of those reported for total chromium, all reported soil concentrations are less than the EPA Generic SSLs for transfers from soil to air (EPA, 1996a). One sample result out of 10 exceeded the SSL_{AIR} for hexavalent chromium. The average total chromium concentration detected in the Raymark waste soil samples (120 mg/kg) is less than the SSL_{AIR} for hexavalent chromium (280 mg/kg). Further evaluation of total chromium concentrations relative to inhalation SSLs for commercial/industrial land use (EPA, 2001a) reveals that all total chromium concentrations detected in the Raymark waste soil samples are less than the commercial/industrial SSL_{AIR} for hexavalent chromium (510 mg/kg). The SSL_{AIR} for chromium assumes that chromium is present in the hexavalent state. The assumption that all chromium is in the hexavalent state is likely to be a conservative assumption.

A qualitative evaluation of potential inhalation risks from exposures to asbestos is presented in Section 3.3.5.4. Asbestos is present in soils within the estimated area of Raymark waste at 230 Ferry Boulevard. The presence of pavement and vegetation and the qualitative comparison to SSLs suggest that exposures to fugitive dust and volatile emissions are currently insignificant, thereby eliminating the need for quantitative evaluation of this exposure pathway.

Estimates of Chemical Intake

Estimates of chemical intake were calculated using the equations presented in Section 2.7.4. Appendix B-1, Table 4.1 contains the various assumptions used as input parameters to determine chemical intakes for commercial workers through ingestion and dermal contact. In order to prorate exposures, the fraction of the property estimated to contain Raymark waste (FRW) is factored into the intake equations shown in Section 2.7.3.4. Table 1-1 presents the property sizes and FRW values for each property. The FRW for 230 Ferry Boulevard is 0.27. Chemical intake estimates for the property are provided in Appendix B-1, Tables 7.3 and 8.3.

3.3.5.4 Risk Characterization

The methods used to estimate the type and magnitude of potential human health risks associated with the exposures to COPCs in soils are described in Section 2.7.5. A summary of the quantitative risk assessment for 230 Ferry Boulevard is provided in this section. Appendix B-1, Table 7.3 and Table 8.3 present non-cancer and cancer RME risk estimates, respectively. Sample calculations are provided in Appendix B-6. Total non-carcinogenic and carcinogenic risks for each exposure route, as well as the cumulative risk, are summarized in Appendix B-1, Table 9.3. Appendix B-1, Table 10.3 reduces the information developed in Appendix B-1, Table 9.3 to the major risk drivers. Results of the evaluations of lead exposures are presented in Appendix B-10.

Non-Carcinogenic Risks

RME hazard indices developed for the commercial worker at 230 Ferry Boulevard were as follows:

	Ingestion	Dermal	Total
Commercial Worker (Current and future)	3.8	3.4	7.2

The RME hazard index (HI) for the commercial worker exposed to soils within the estimated area of Raymark waste is in excess of unity. Total Aroclor was the main contributor to the hazard index for the commercial worker. The chemical-specific (and target-organ specific) hazard quotients for total Aroclors alone are in excess of unity for commercial receptors. Adverse non-carcinogenic health effects are possible from exposure to Aroclors. See Table 7.3 RME in Appendix B-1 for details on non-cancer hazard index calculations.

Carcinogenic Risks

Incremental RME cancer risk estimates for the commercial worker at 230 Ferry Boulevard were as follows:

	Ingestion	Dermal	Total
Commercial Worker (Current and future)	2.0E-04	1.1E-04	3.2E-04

The EPA cancer risk range is 10^{-4} to 10^{-6}. The CT DEP target cancer risk level is 10^{-6} for single contaminants and 10^{-5} for total risk from multiple contaminants. The RME risk estimate for the commercial worker exposed to soils within the estimated area of Raymark waste exceeds the EPA cancer risk range (10^{-4} to 10^{-6}) and the CT DEP target total risk level of 10^{-5} for multiple contaminants. See Table 8.3 RME in Appendix B-1 for details on cancer risk calculations. As detailed on Appendix B-1, Table 9.3, dioxins, Aroclors, arsenic, benzo(a)anthracene, dibenzo(a,h)anthracene, and benzo(a)pyrene are the predominant risk drivers, with estimated cancer risks greater than the CT DEP target risk level for single contaminants of 10^{-6}.

Cancer risk estimates for dioxins, shown on the tables referenced above and included in the discussion above were calculated using the CSF for 2,3,7,8-TCDD of 1.5E+5 $(mg/kg/d)^{-1}$ from IRIS (EPA, 2003). As discussed in Section 2.7.4.2, this CSF is undergoing EPA review. Cancer risk estimates for dioxins calculated using the CSF for dioxins of 1E+6 $(mg/kg/d)^{-1}$ from the Draft Dioxin Reassessment (EPA, 2000) are presented in Appendix B-9. Total cancer risks estimated

using the Draft Dioxin Reassessment CSF for dioxin for commercial workers exposed to soils within the estimated area of Raymark waste at this property are 1.4E-03.

Exposure to Lead

Lead was identified as a COPC in soils within the estimated area of Raymark waste at the 230 Ferry Boulevard property. Lead was detected in samples collected from 0 to 15 feet bgs within the estimated area of Raymark waste at a maximum concentration of 40,100 mg/kg. The average lead concentration in this dataset was 6,620 mg/kg.

Exposure to lead in soil by the commercial worker was evaluated by use of a slope-factor approach developed by the EPA Technical Review Workgroup for Lead (EPA, December 1996d), as discussed in Section 2.7.4.7. The exposure point concentration of 6,620 mg/kg for soil within the estimated area of Raymark waste at 230 Ferry Boulevard was used to estimate the probability that the fetal blood-lead levels of fetuses born to workers exposed to lead in a commercial setting will exceed 10 µg/dL. In order to prorate exposures, the fraction of the property estimated to contain Raymark waste (FRW) is factored into the intake equations shown in Appendix B-10. The FRW for 230 Ferry Boulevard is 0.27. EPA's stated goal for lead is that individuals exposed would have no more than 5 percent probability of exceeding the level of concern of 10 µg/dL. Under the commercial scenario for the estimated area of Raymark waste at 230 Ferry Boulevard, the range of probabilities that the fetal blood-lead concentration exceeds 10 µg/dL is 9 to 12 percent. The input parameters used and the results of lead models are presented in Appendix B-10.

Exposure to Asbestos

Asbestos was detected in 22 of 24 soil samples collected from the estimated area of Raymark waste at a concentration range of trace to 90 percent. These samples were collected from the 0- to 15- foot bgs interval. The average concentration was 22 percent. Although quantitative risk estimates (inhalation risk estimates) have not been developed for this parameter, it should be noted that asbestos-containing material is defined as material containing more than 1 percent asbestos (Appendix A to Subpart M of 40 CFR 61)(EPA, 1990). Asbestos is considered a potential inhalation hazard if it is "friable" (can be crumbled, pulverized, or reduced to powder) and, consequently, subject to entrainment/migration into the air.

The presence of pavement and vegetative cover in the estimated area of Raymark waste reduces the potential for airborne asbestos at 230 Ferry Boulevard. Based on field conditions in the estimated area of Raymark waste, it is likely that asbestos does not currently present a significant inhalation risk from the estimated area of Raymark waste at this property. If asbestos containing soils are disturbed, the potential for airborne asbestos exposure and associated inhalation risks exists.

3.3.5.5 Uncertainties

A detailed discussion of uncertainties associated with the various aspects of risk assessment, in general, was provided in Section 2.7.6. Area-specific uncertainties for 230 Ferry Boulevard are presented in the following narrative.

- Uncertainty associated with the extent of the estimated area of Raymark waste adds uncertainty in the risk assessment. The associated uncertainties propagate through the risk assessment, not only in which samples are included in the evaluation, but also in the exposure assessment, which relies on prorating of exposure intake based on the percentage of the property estimated to contain Raymark waste. Uncertainty in the identification of samples meeting the definition of Raymark waste includes accuracy and precision of analytical methods. Limitations in the determination of the areal extent of Raymark waste for each property are discussed in Section 2.3.

- The use of the FRW factor in prorating exposures assumes that individual receptors will spend time within the estimated area of Raymark waste in direct proportion to the percent of the property estimated to contain Raymark waste. The total area of the 230 Ferry Boulevard property is 2.5 acres, with an estimated 27 percent containing Raymark waste. A physical description of the estimated area of Raymark waste at the property is provided in Section 3.3.4. The estimated area of Raymark waste is mostly paved. No consideration has been given to site characteristics other than the presence of buildings. It is conceivable that individuals may spend all of their time within the estimated area of Raymark waste. In this case, because risks were estimated assuming individuals would only be exposed to contaminated soils 27 percent of the time, total reasonable maximum

risks for exposure to the estimated area of Raymark waste would be approximately four times greater than those estimated using the FRW factor.

- Soil concentrations in background locations are discussed in Section 2.5.3 and presented in Table 2-2. Average background concentrations are also shown in Appendix B-1, Table 2.3, alongside site-specific data from the estimated area of Raymark waste. Arsenic, with an average background concentration of 5.67 mg/kg, was detected at concentrations ranging from 4.7 to 8.8 mg/kg, with an average concentration of 6.0 mg/kg. Risks due to arsenic may be attributable to background conditions.

- Dioxins were selected as COPCs. Since new toxicological information has become available, cancer risks based on the CSF of 1.5×10^5 $(mg/kg/day)^{-1}$ may underestimate risks. Cancer risks from dioxins based on the proposed CSF of 1.0×10^6 $(mg/kg/day)^{-1}$ for dioxins are presented in Appendix B-9. These risks are approximately an order of magnitude greater than risks estimated using the CSF of 1.5×10^5 $(mg/kg/day)^{-1}$.

- Twenty-four samples were included in the dataset for soils within the estimated area of Raymark waste; however, 14 of those samples were only analyzed by field-screening methods. Due to limited numbers of samples analyzed for dioxins, Aroclors, benzo(a)anthracene, benzo(a)pyrene, and barium, maximum concentrations were used to evaluate risks for these parameters. The use of maximum concentrations and small datasets adds uncertainty to the risk estimates.

- Samples collected from depths of 0 to 15 feet bgs were included in the risk assessment for current and future commercial workers. Current exposures to commercial workers are likely to involve only contact with surface soils. For this reason, inclusion of deeper soils adds uncertainty to the estimate of risks for current commercial workers.

- In the absence of chromium speciation data, toxicity values for chromium VI were used to estimate risks from measured total chromium concentrations. Since hexavalent chromium is considered to be more toxic than the trivalent state, which is more common, risks for this chemical are probably overestimated to some degree.

- A comparison of soils data from the property outside the estimated area of Raymark waste to CT RSRs is provided in Appendix B-10. The presence of chromium at concentrations greater than CT RSRs for industrial soil suggests that risks from other areas of the property may be of concern. Chromium is present in soils located outside the estimated area of Raymark waste at 230 Ferry Boulevard at concentrations up to 102 mg/kg. Dioxins were detected in soils outside the estimated area of Raymark waste; however, no CT RSRs are available for dioxins. Dioxin TEQ concentrations outside the estimated area of Raymark waste exceed EPA Region IX PRGs for industrial soil in one sample.

- Five samples from outside the estimated area of Raymark waste were analyzed for PCBs using CLP methods. While none of these samples had concentrations greater than the CT RSRs for industrial soil, one sample did have total Aroclor concentrations greater than the EPA Region IX PRG for industrial soil. The only individual Aroclor detected was Aroclor 1268. Lead and copper were detected at concentrations up to 900 mg/kg and 501 mg/kg, respectively. Asbestos is also present outside the estimated area of Raymark waste at this property at concentrations up to 20 percent. Thus, a commercial worker's exposure and risk from the entire property are likely to be greater than that estimated for the area of Raymark waste alone.

3.3.5.6 Summary of Human Health Risk Assessment

This section presents a summary of major risk assessment findings for soils estimated to contain Raymark waste at 230 Ferry Boulevard. Risks to current and future commercial workers were estimated.

- The RME hazard indices (HI) for current and future commercial workers exposed to soil within the estimated area of Raymark waste at 230 Ferry Boulevard are in excess of unity. The chemical-specific (and target organ-specific) hazard quotients for total Aroclor alone are in excess of unity. Adverse non-carcinogenic health effects are possible from exposure to Aroclors.

- The RME cancer risk estimates for current and future commercial workers exposed to soil within the estimated area of Raymark waste exceed the EPA cancer risk range (10^{-4}

to 10^{-6}) and the CT DEP target total risk level of 10^{-5}. Dioxins, Aroclors, arsenic, benzo(a)anthracene, dibenzo(a,h)anthracene, and benzo(a)pyrene are the predominant risk drivers, with estimated cancer risks greater than the CT DEP target risk level for single contaminants of 10^{-6}.

- Exposure to lead in soil by commercial workers was evaluated by use of a slope-factor approach developed by the EPA Technical Review Workgroup for Lead (EPA, December 1996d). The results of the slope-factor approach indicate that adverse effects are anticipated for fetuses of pregnant workers exposed to lead in soil within the estimated area of Raymark waste at 230 Ferry Boulevard.

- Asbestos was detected in 22 of 24 soil samples collected from the estimated area of Raymark waste in the 0- to 15- foot bgs interval at a concentration range of trace to 90 percent. The average concentration was 22 percent.

3.3.6 Ecological Evaluation

No ecologically significant habitats are present on this property. Portions of the swale channel are considered to be wetland. No fish or wildlife have been observed in the swale. The small size of the swale, its function as a stormwater drainage ditch, surrounding development, visible surface contamination, and monoculture of *Phragmites australis*, severely limit its present habitat value and ecological functions. The ecological characterization of the wetlands on this property was addressed under the OU3 Area I RI (TtNUS, 1999b) and is presented in the *Draft Technical Memorandum Wetland Evaluation, Raymark-Ferry Creek-OU3* (B&RE, 1998). A summary of the findings is presented below. It should be noted, however, that no individual evaluation of the ecological impacts to this property was performed.

Most of the property has been disturbed by surrounding development, past uses of Ferry Creek, and filling of a wetland area prior to developing the property. There are no wetlands on the property, but the parcel abuts Ferry Creek. There is limited vegetation on the parcel as most of the property is covered by a building or pavement.

This property provides only limited use as an area for birds, reptiles, and small mammals to forage, cover, rest, and breed because of the level of development, soil contamination,

disturbed nature of the area, and the low vegetation density and diversity. Wildlife identified in the area include red-winged blackbird (*Agelaius phoeniceus*) and green heron (*Butorides striatus*).

3.3.7 Summary

This 2.5-acre commercially zoned property abutting Ferry Creek contains Raymark waste. Soils containing dioxins, metals (including SPLP metals), pesticides, PCBs, SVOCs, and VOCs that exceed CT DEC and/or CT PMC criteria or contain more than 1 percent asbestos are present on the property. For the portion of the property not covered by building or pavement, infiltration and leaching is likely occurring, especially to the rear of the property where the asphalt is cracking. In addition, the slow-moving water in the swale located on the northern edge of the property likely infiltrates and leaches into the groundwater.

RME hazard indices for commercial workers exposed to soil within the estimated area of Raymark waste are in excess of unity, indicating that adverse health effects are possible. The RME cancer risk estimates exceed the EPA cancer risk range and the CT DEP total risk level. Dioxins, aroclors, arsenic, benzo(a)anthracene, dibenzo(a,h)anthracene, and benzo(a)pyrene are the predominant risk drivers. Adverse effects from lead are anticipated for fetuses of pregnant workers exposed to the soil within the estimated area of Raymark waste. The average asbestos concentration in the estimated area of Raymark waste was 22 percent.

Ecological risks have not been quantified; however, some impacts to the environment by onsite contaminants are assumed, especially along Ferry Creek where there is some erosion of the fill along the bank. The swale area appears to have a higher concentration of contaminants in the shallow area, which may erode into Ferry Creek during times of high water.

TABLE 3-3
230 FERRY BOULEVARD - SOIL ANALYTICAL RESULTS **
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
REMEDIAL INVESTIGATION
RAYMARK - OU6
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Average Detected Conc.	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Industrial) (1) (2)	Number of Exceedances of CT DEC (1) (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)
Asbestos (%)										
Asbestos	51	63	11	14	Trace	90	1	40		
Dioxin (UG/KG)										
1,2,3,4,6,7,8-HpCDD	6	6	0.94	0.94	0.04974 J	4.1 J				
1,2,3,4,6,7,8-HpCDF	6	6	5.9	5.9	0.03641 J	24 J				
1,2,3,4,7,8,9-HpCDF	4	6	0.019	0.026	0.00502	0.0474				
1,2,3,4,7,8-HxCDD	5	6	0.008	0.0081	0.00057 J	0.0154				
1,2,3,4,7,8-HxCDF	6	6	4.6	4.6	0.01003 J	21.4 J				
1,2,3,6,7,8-HxCDD	5	6	0.034	0.04	0.00182 J	0.101				
1,2,3,6,7,8-HxCDF	6	6	1.1	1.1	0.00414 J	4 J				
1,2,3,7,8,9-HxCDD	5	6	0.029	0.033	0.00128 J	0.0732				
1,2,3,7,8,9-HxCDF	3	6	0.0041	0.0044	0.00041	0.0066 EMPC				
1,2,3,7,8-PeCDD	6	6	0.099	0.099	0.000186	0.5512 *				
1,2,3,7,8-PeCDF	6	6	2.4	2.4	0.00551 J	11.5 J				
2,3,4,6,7,8-HxCDF	6	6	1.9	1.9	0.00626 J	8.1 J				
2,3,4,7,8-PeCDF	6	6	5.3	5.3	0.00953 J	26.4 J				
2,3,7,8-TCDD	4	6	0.0028	0.0025	0.000237	0.0047				
2,3,7,8-TCDF	6	6	4.7	4.7	0.00684	24.3 J				
OCDD	6	6	4.3	4.3	1.587	9.2 J				
OCDF	6	6	0.73	0.73	0.05638 J	1.39				
Total HpCDD	6	6	3.3	3.3	0.115	16.55 J				
Total HpCDF	6	6	6.6	6.6	0.05408 J	27.18 J				
Total HxCDD	6	6	1.1	1.1	0.01817 J	5.17 J				
Total HxCDF	6	6	17.5	17.5	0.05966 J	79.72 J				
Total PeCDD	6	6	20.6	20.6	0.000523	122.7 *				
Total PeCDF	6	6	24.7	24.7	0.0531	121.2 J				
Total TCDD	5	6	4.4	5.2	0.000237	26.02 *				
Total TCDF	5	6	14.7	17.6	0.0154	72.78 J				
Toxicity Equivalency	6	6	4.1	4.1	0.0139 J	20.14 J				

TABLE 3-3 (cont.)
230 FERRY BOULEVARD - SOIL ANALYTICAL RESULTS **
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
REMEDIAL INVESTIGATION
RAYMARK - OU6
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Average Detected Conc.	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Industrial) (1) (2)	Number of Exceedances of CT DEC (1) (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)
Metals (MG/KG)										
Aluminum	14	14	10900	10900	5120	15700 J				
Arsenic	9	14	5.1	6.6	4.7	8.8	10	0		
Barium	14	14	3620	3620	49.7 J	16700	140000	0		
Beryllium	10	13	0.54	0.62	0.39	0.88	2	0		
Cadmium	9	14	0.65	0.86	0.46	1.8	1000	0		
Calcium	14	14	6000	6000	1190	32600				
Chromium	14	14	98.4	98.4	17.3	301	100	6		
Cobalt	14	14	12.1	12.1	4.5	37	2500	0		
Copper	29	50	3500	5960	26.8	36300	76000	0		
Iron	14	14	20100	20100	9430	29500 J				
Lead	51	63	2610	3210	33	40100	1000	12		
Magnesium	14	14	18000	18000	4210	76700				
Manganese	14	14	236	236	124	324	47000	0		
Mercury	9	14	0.44	0.65	0.1 J	1.5	610	0		
Nickel	14	14	104	104	15	469	7500	0		
Potassium	13	14	1830	1960	713	3640 J				
Selenium	4	14	0.81	0.94	0.47 J	1.6 J	10000	0		
Silver	6	14	0.86	1.6	0.77	2.6	10000	0		
Sodium	12	13	2710	2930	158	17000 J				
Vanadium	14	14	33.3	33.3	15.7	48.7	14000	0		
Zinc	14	14	784	784	51.1 J	3790	610000	0		
Metals (SPLP) (UG/L)										
Aluminum	3	3	10900	10900	1030	25600				
Antimony	1	5	4.3	15.3	15.3	15.3			60	0
Arsenic	4	5	16.1	19.3	1.5 J	65.8			500	0
Barium	5	5	290	290	68.4	720 J			10000	0
Beryllium	1	5	1.4	5.6	5.6	5.6			40	0
Cadmium	2	5	4.5	10.8	0.45	21.1			50	0

TABLE 3-3 (cont.)
230 FERRY BOULEVARD - SOIL ANALYTICAL RESULTS **
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
REMEDIAL INVESTIGATION
RAYMARK - OU6
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Average Detected Conc.	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Industrial) (1) (2)	Number of Exceedances of CT DEC (1) (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)
Metals (SPLP) (UG/L) (cont.)										
Calcium	3	3	37200	37200	8250	73800 J				
Chromium	5	5	215	215	2.3	1060 J			500	1
Cobalt	2	3	16.8	24.6	3.5	45.8				
Copper	5	5	1390	1390	50.1	5190 J			13000	0
Iron	3	3	23100	23100	486	63100 J				
Lead	5	5	519	519	69	1760 J			150	2
Magnesium	3	3	4810	4810	1650	10100				
Manganese	3	3	749	749	11.5	2100 J				
Mercury	1	5	0.22	0.3	0.3	0.3			20	0
Nickel	5	5	37.3	37.3	5.4	146 J			1000	0
Potassium	3	3	2500	2500	1120	4980 J				
Selenium	1	5	3.2	8.2	8.2 J	8.2 J			500	0
Sodium	3	3	4880	4880	3440	7350				
Vanadium	5	5	45.2	45.2	0.76 J	170			500	0
Zinc	5	5	1060	1060	26	4610			50000	0
Semivolatile Organic Compounds (UG/KG)										
1,4-Dichlorobenzene	1	7	340	66	66	66	240000	0	15000	0
2-Methylnaphthalene	7	13	300	260	32 J	990	2500000	0	9800	0
2-Methylphenol	1	13	330	120	120 J	120 J	2500000	0	70000	0
4-Methylphenol	2	13	320	190	170 J	210 J	2500000	0	7000	0
Acenaphthene	8	13	340	320	57 J	1100	2500000	0	84000	0
Acenaphthylene	7	13	420	460	56 J	2100	2500000	0	84000	0
Acetophenone	6	6	880	880	180 J	1600				
Anthracene	11	13	900	980	110 J	5700	2500000	0	400000	0
Benzaldehyde	5	6	520	570	200 JEB	890 JEB				
Benzo(a)anthracene	11	13	1600	1700	140 J	9100 *	7800	1	1000	4
Benzo(a)pyrene	12	13	1600	1700	140 J	9100 *	1000	5	1000	5
Benzo(b)fluoranthene	12	13	1300	1400	160 J	6200 *J	7800	0	1000	5

TABLE 3-3 (cont.)
230 FERRY BOULEVARD - SOIL ANALYTICAL RESULTS **
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
REMEDIAL INVESTIGATION
RAYMARK - OU6
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Average Detected Conc.	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Industrial) (1) (2)	Number of Exceedances of CT DEC (1) (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)
Semivolatile Organic Compounds (UG/KG) (cont.)										
Benzo(g,h,i)perylene	12	13	720	740	81 J	4300	2500000	0	42000	0
Benzo(k)fluoranthene	12	13	1300	1400	110 J	6300	78000	0	1000	4
bis(2-Ethylhexyl)phthalate	8	13	330	160	93	260 J	410000	0	11000	0
Carbazole	8	13	420	450	65 J	1900	290000	0	360	3
Chrysene	12	13	1800	1900	220 J	9200 *	780000	0	1000	5
Dibenzo(a,h)anthracene	7	13	470	540	130 J	2300	780	1	1000	1
Dibenzofuran	6	13	390	460	24 J	1600	2500000	0	5600	0
Dimethylphthalate	1	13	320	70	70 J	70 J	2500000	0	1100000	0
Di-n-Butylphthalate	3	13	470	130	72 J	210 J	2500000	0	140000	0
Di-n-octylphthalate	1	13	330	30	30 J	30 J	2500000	0	20000	0
Fluoranthene	13	13	3900	3900	160 J	23000 *	2500000	0	56000	0
Fluorene	11	13	410	410	48 J	1700	2500000	0	56000	0
Indeno(1,2,3-cd)pyrene	12	13	850	880	100 J	4600	7800	0	1000	2
Naphthalene	6	13	380	420	64 J	1300	2500000	0	56000	0
N-Nitroso-diphenylamine	2	13	330	160	120 J	200 J	1200000	0	1400	0
Phenanthrene	12	13	3000	3200	240 J	19000 *	2500000	0	40000	0
Phenol	7	12	750	990	370 JEB	2400	2500000	0	800000	0
Pyrene	13	13	3800	3800	190 J	23000 *J	2500000	0	40000	0
Total PAH	2	2	14000	14000	2380	26110				
Volatile Organic Compounds (UG/KG)										
1,1,1-Trichloroethane	1	8	15	4	4 J	4 J	1000000	0	40000	0
1,2,4-Trichlorobenzene	1	6	7	2	2 J	2 J	2500000	0	14000	0
1,3-Dichlorobenzene	1	6	7	1	1 J	1 J				
1,4-Dichlorobenzene	3	6	6	2	2 J	3 J	240000	0	15000	0
2-Butanone	6	8	21	15	5 J	34	1000000	0	80000	0
Acetone	4	8	68	100	45 TB	180	1000000	0	140000	0
Benzene	2	8	47	170	3 J	330	200000	0	200	1

TABLE 3-3 (cont.)
230 FERRY BOULEVARD - SOIL ANALYTICAL RESULTS **
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
REMEDIAL INVESTIGATION
RAYMARK - OU6
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Average Detected Conc.	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Industrial) (1) (2)	Number of Exceedances of CT DEC (1) (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)
Volatile Organic Compounds (UG/KG) (cont.)										
Bromomethane	5	8	17	10	3 J	19				
Carbon Disulfide	6	8	14	6	2 J	12 J	1000000	0	140000	0
Chlorobenzene	4	8	14	5	2 J	8 J	1000000	0	20000	0
Chloroethane	4	8	16	8	3 J	14 J	1000000	0	2400	0
Chloromethane	5	8	24	21	3 J	44	440000	0	540	0
cis-1,2-Dichloroethene	2	6	7	4	2 J	6 J				
Ethylbenzene	3	8	130	340	8 J	1000	1000000	0	10100	0
Isopropylbenzene	4	6	4	3	2 J	3 J				
Methyl Acetate	1	6	8	8	8 J	8 J				
Methylcyclohexane	4	6	12	15	5 J	35				
Methylene Chloride	1	8	17	14	14 TB	14 TB	760000	0	1000	0
Toluene	5	8	22	31	3 J	85	1000000	0	67000	0
Total Xylenes	7	8	250	290	2 J	1800	1000000	0	19500	0
Trichloroethene	2	8	15	5	3 J	7 J	520000	0	1000	0
Vinyl Chloride	1	8	15	3	3 J	3 J	3000	0	400	0
Pesticide/PCB (UG/KG)										
4,4'-DDD	1	14	14	6.2	6.2	6.2	24000	0	29	0
4,4'-DDE	2	14	20	80	69	90	17000	0	21	2
alpha-Chlordane	1	14	7	3.9	3.9	3.9	2200	0	66	0
Aroclor, Total (4)	31	51	18000	30000	150	231000	10000	9		
Aroclor, Total (Conservative) (5)	31	51	21000	34000	330	278000	10000	10		
Aroclor-1248	1	18	780	6200	6200 J	6200 J	10000	0		
Aroclor-1262	20	38	5500	9900	120	71000 J	10000	5		
Aroclor-1268	30	49	15000	24000	120	230000	10000	9		
Dieldrin	4	14	21	36	4.6	93	360	0	7	3
Endosulfan II	2	14	13	5.4	2.5 J	8.3	1200000	0	8400	0
Endosulfan Sulfate	6	14	1200	2800	16 #	7300 #	1200000	0	8400	0

TABLE 3-3 (cont.)
230 FERRY BOULEVARD - SOIL ANALYTICAL RESULTS **
SUMMARY STATISTICS AND COMPARISON TO CRITERIA
REMEDIAL INVESTIGATION
RAYMARK - OU6
STRATFORD, CONNECTICUT

PARAMETER	Positive Detects	Number of Samples Analyzed	Average Conc.	Average Detected Conc.	Minimum Detected Conc.	Maximum Detected Conc.	CT DEC (Industrial) (1) (2)	Number of Exceedances of CT DEC (1) (2)	CT PMC (GB) (3)	Number of Exceedances of CT PMC (3)
Pesticide/PCB (UG/KG) (cont.)										
Endrin Aldehyde	6	14	210	480	14	1400 #	610000	0		
Endrin Ketone	1	14	14	10	10	10	610000	0		
gamma-Chlordane	3	14	25	92	4	260 J	2200	0	66	1
Heptachlor	1	14	7	2.7	2.7	2.7	1300	0	13	0
Methoxychlor	5	14	200	490	7.2 J	1100	10000000	0	8000	0

Qualifier	Definition
#	Possible false positive due to interference
*	From dilution analysis or Estimated Maximum Possible Concentration (Dioxins only)
EB	Equipment blank contamination
EMPC	Estimated Maximum Possible Concentration
J	Quantitation approximate
TB	Trip blank contamination

Notes:

** Analytical results in this table are from samples collected throughout the property, not just the estimated area of Raymark Waste.
(1) Asbestos is included with a criterion of 1% in the CT DEC column for comparison purposes. It's criterion is not a promulagated CT Remediation Standard Regulation.
(2) CT DEC - Direct Exposure Criteria for Residential or Commercial/Industrial Soils. CT Remediation Standard Regulations, January 1996, and additional approved criteria.
(3) CT PMC - Pollutant Mobility Criteria for soils in a GB aquifer area. CT Remediation Standard Regulations, January 1996, and additional approved criteria.
(4) Aroclor, Total is the sum of the results of all detected individual Aroclors.
(5) Aroclor, Total (Conservative) is the sum of the results of all detected individual Aroclors and one half the detection limit of non detected individual Aroclors.

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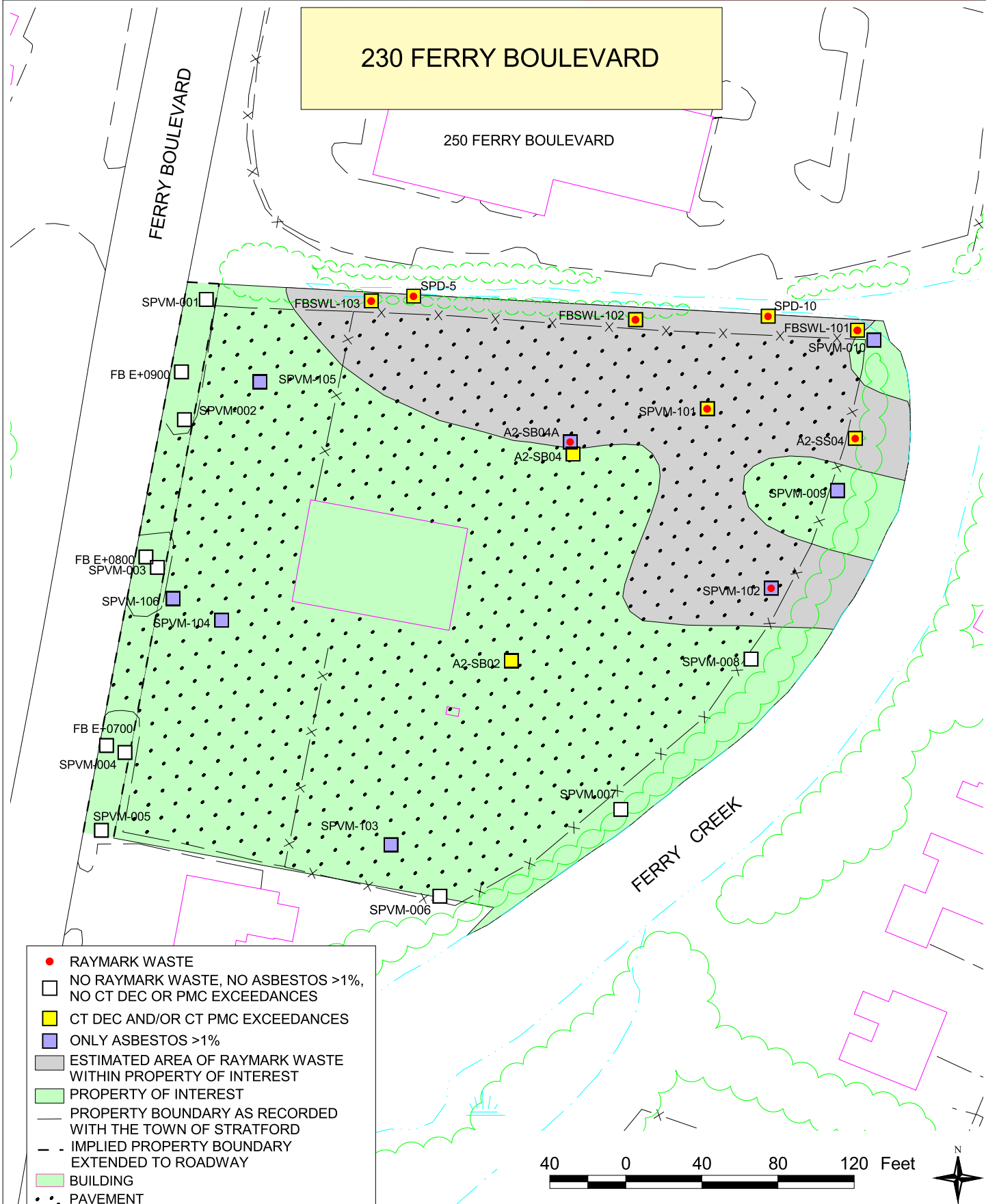

NOTES:
1) PLAN NOT TO BE USED FOR DESIGN
2) ALL LOCATIONS TO BE CONSIDERED APPROXIMATE
3) PROPERTY BOUNDARIES ARE APPROXIMATE BASED ON TOWN OF STRATFORD ENGINEERING DEPARTMENT PLANS
4) DUE TO UNCERTAINTIES OF PROPERTY BOUNDARIES DURING THE SAMPLING PROCESS, SAMPLES LOCATED ADJACENT TO THE PROPERTY ARE UNDERSTOOD TO BE ON THE PROPERTY
5) CT DIRECT EXPOSURE CRITERIA (CT DEC) FOR INDUSTRIAL/COMMERCIAL SOILS AND CT POLLUTANT MOBILITY CRITERIA (CT PMC) USED TO DETERMINE EXCEEDANCES.

SOIL SAMPLE LOCATIONS	FIGURE 3-3
RAYMARK - OU6	TETRA TECH NUS, INC.
STRATFORD, CONNECTICUT	
DRAWN BY: L. SEYDEWITZ / DATE: APRIL 27, 2004	55 JONSPIN ROAD WILMINGTON, MA 01887
CHECKED BY: D. CHISHOLM / FILE: C\...\OU6_RI_2003.APR	(978)658-7899